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# BOTANY.—*A new form of the moonvine* Calonyction aculeatum *with divided corolla limb, and length-of-day behavior and flowering of the common form.*[1]

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The corolla limb of the moonvine *Calonyction aculeatum* is normally undivided. A form has been discovered differing from the typical form only by having the corolla limb divided into five (sometimes four) rounded, distinctly clawed segments. This distinctive form, which appears to have arisen as a mutant, seems worthy of a name and is diagnosed as follows:

**Calonyction aculeatum** (L.) House f. **apopetalum** Allard, forma nova

Limbus corollae in segmenta 5 (interdum 4) unguiculata divisus.

Type material has been deposited in the U. S. National Herbarium under the number 1871928. Isotypes have also been deposited in the general herbarium collection and the herbarium of introduced plants under the numbers 1871929 and 1871930, respectively. An abundance of herbarium material of the original type plant has been distributed among other large herbaria in the United States, including the Herbarium of the National Arboretum at Beltsville, Md., and the Gray Herbarium at Harvard University.

## ORIGIN OF THE NEW FORM

For many years I have grown a number of moonvines each summer at Arlington, Va. As this vine is a native of the American Tropics, where cold is never experienced, the plants are not constituted to withstand winter severity at any stage in northern latitudes. A few plants, however, usually appear spontaneously each spring in my garden. The survival of such seeds seems to be favored by the very hard, impermeable seed coat and the protection afforded by an abundance of leaf litter, which may sometimes accidentally cover and protect them from freezing.

In October 1943 a vigorous seedling appeared in my garden under such circumstances and was left undisturbed until some time in November. For a brief period it was covered with a bucket to protect it from frost; then when it had begun to show signs of injury from the cold nights it was transplanted to a bucket in the warm greenhouse. Here it grew vigorously throughout the winter but showed no evidence of flowering until late in March and April, when the first buds appeared. Early in May 1944 the plant was transferred from the bucket to a spot in my garden where it could climb a high wire fence.

The first open blossom appeared on the evening of June 20. From this date new flowers appeared nightly, their number increasing throughout July and August, and on several nights as many as 45 flowers were displayed at one time. The first ripe seed pods appeared on July 7, the seed coat being mostly brownish in color. The usual color is a uniform black, but some plants produce seeds with entirely white seed coats. In all, 1,015 blossoms appeared on this vine up to and including September 16. Few blossoms appeared after that date.

The corolla limb was divided usually into five broad, rounded, distinctly clawed segments. Only four blossoms departed from this form, these being distinctive in having four segments. The twist of the lobes in the

[1] Received October 12, 1944.

bud is similar to that of the normal form, the direction of twist being clockwise, or from right to left. The pollen grains, as in the normal form, average about 160.15$\mu$ in diameter, ranging from 144$\mu$ to 165.6$\mu$.

The moonvine normally produces five exserted stamens, which are adnate to the corolla tube, a stamen being situated below or in line with each sinus. In those blossoms having only four lobes, however, or four sinuses, the stamens are always four in number.

Numerous cuttings have been rooted from the original plant and cross pollinations with the normal unlobed form have been made to determine the genetic behavior of the mutant form. An abundance of selfed seed has also been obtained from the original plant, since it was induced to flower very early outdoors and has continued to flower until fall. The moonvine normally does not flower around Washington, D. C., until late in July or August when grown from seeds planted outdoors in May.

## LENGTH-OF-DAY BEHAVIOR OF THE MOONVINE

The length-of-day behavior of the moonvine appears to be typical of that of many tropical plants, since it can flower in response to days only 12 hours long at the Equator and also during the much longer days that prevail during the warm growing season in middle latitudes.

Experiments carried out 15 or 16 years ago with seedlings subjected to various constant lengths of day from April 17, the date of germination, have revealed that days much below 12 hours in length may be unfavorable to flowering. The plants experiencing a 10-hour day never flowered, while the plants experiencing a 12-hour day and the controls experiencing full day began flowering July 27. The plants experiencing full day showed indications of becoming less floriferous and finally ceased flowering in September. Since this behavior may have been considered the result of aging, or a response due to lowering temperatures, further studies were made. To test this point a plant was transferred to a large bed of soil in the warm greenhouse September 27. This plant remained in a vigorous growing condition throughout the winter, but buds did not appear until March 29.

The plants experiencing the 10-hour day, which had never flowered, were also brought into the warm greenhouse and given the same conditions. These plants likewise failed to produce buds until April.

The mutant form that germinated in October showed the same nonflowering tendency throughout the winter, since in the warm greenhouse buds did not appear until late in March and early in April, a period of at least 162 days. Experiments have shown that normal plants will flower at Washington, D. C., in summertime when planted outdoors in about 100 days, which is about two months sooner.

This would indicate that the moonvine may show a more or less intermediate behavior in its flowering, since days as short as 10 or 11 hours do not appear favorable to free flowering. Whether there are upper limits with days too long for flowering is not known. A length of day of 14.9 hours from sunrise to sunset, which is the longest day prevailing in the Washington area, does not appear to be very unfavorable to flowering when earlier flowering has been induced.

## OTHER CHARACTERISTICS

The moonvine is a very ornamental climber and a worthy addition to any garden. Its big, immaculately white flowers, exhaling a delightful perfume, opening at dusk and enduring until the next morning, always excite admiration in the lover of flowers. The flowers appear to self-pollinate very readily, as the anthers, usually closely investing the stigma in the bud, have dehisced and exposed their large pollen grains even before the flowers have actually expanded their corollas. If plants can be started in the greenhouse in winter and grown to good size before transplanted into the garden in May, flowering can be induced a month or more in advance of those grown from seed outdoors.

The common peduncle of the flowers and the pedicels of the individual blossoms show a strong negatively geotropic behavior, and so the buds and flowers are usually held stiffly erect. After flowering and pollination the thick, enlarged pedicel of the

opened blossom bends downward sharply under the influence of a positive geotropism, causing the enlarging, immature capsules to point earthward. This positive geotropism affects only the individual maturing blossoms of the cluster. Experiments have shown that when the stamens are removed and fertilization is prevented, the pedicels do not bend earthward, and after yellowing they finally dehisce at the base and fall off.

The moonvine under normal summer conditions is a nocturnal flowering plant and in warm weather opens its flowers in the evening some time after sundown. The flowers soon wither the next morning. As the autumn days approach and cooler weather intervenes, the opening of the flowers may be retarded. When the night temperatures become too low the time of flowering is completely reversed. The plants then behave like the morning-glories, their flowers opening only during the day and persisting even until the next day.

During the warm days of late summer the nocturnal flowering of the moonvine is a very persistent behavior. Some years ago I cut off the main stem of a large flowering plant at the ground and noted its subsequent behavior. This plant continued to open its blossoms in the evening at the normal time for one or two evenings until profound wilting had set in.

It would be of some interest to know whether the flowering of the moonvine is seasonal and becomes reduced in the tropical and subtropical conditions of its native home when the shortest days prevail.

As previously stated, flowering outdoors becomes noticeably reduced in September, but lower temperatures conceivably might be an unfavorable condition here. However, plants kept in a greenhouse with warm summer temperatures still tend to become nonflowering. Some change in light conditions appears to be responsible for this behavior. Not only do greatly shortened days intervene in wintertime, but also there is reduction in ultraviolet and other qualities of radiation in the greenhouse during the winter months in temperate regions. Furthermore, there is a great reduction in intensity of radiation throughout the win-

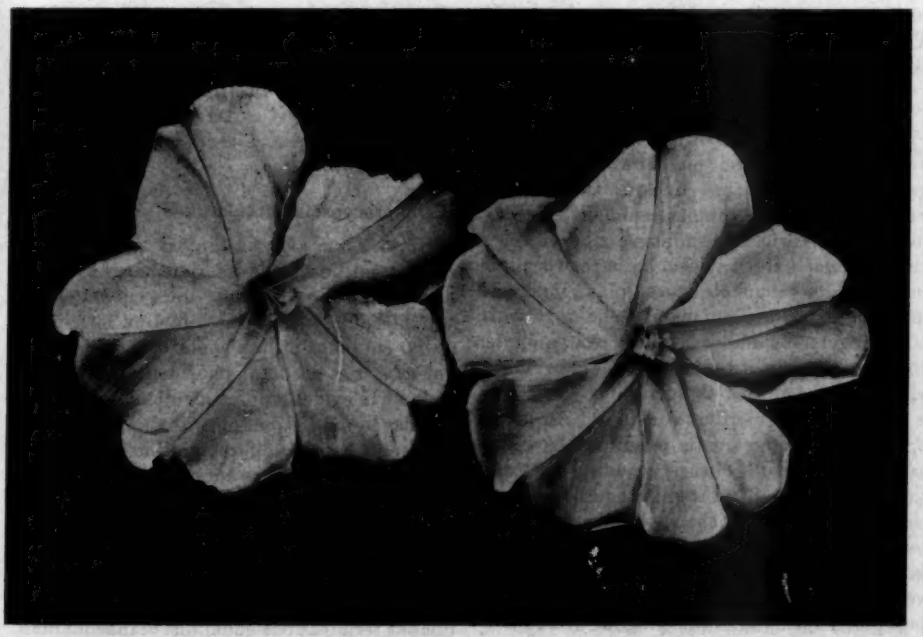

FIG. 1.—Blossoms of mutant form of moonvine, *Calonyction aculeatum* f. *apopetalum*; 0.58 natural size.

ter, since the average maximum intensity is perhaps less than 1,000 foot-candles in comparison with an average of 10,000 foot-candles in summertime. It is evident, then, that while a shortened length of day may appear to explain the nonflowering tendency of the plants in wintertime, this may not be the only factor involved at this season. The failure of the plants to flower under daily durations of summer sunlight of 10 hours, as tests have shown, would appear to be correctly explained as a length-of-day response.

While the moonvine is highly regarded in our gardens only for its beauty, the natives of Central America long ago somehow learned that a decoction of the macerated plant would coagulate the latex of the castilla tree in the production of its rubber. This coagulating characteristic has been studied and a resin has been isolated[2] that may find use in the commercial production of castilla rubber.

The scientific name *Calonyction* is a most appropriate one for this lovely flower, being a compound of the Greek words *kalos*, beautiful, and *nyktios*, nightly, meaning beautiful at night. Surely the flower deserves this characterization.

The flowers are so very fragrant during the warm summer nights that their delightful perfume can be detected some distance from the plants. However, during the cool autumn days and nights the blossoms are almost entirely devoid of fragrance.

[2] WILDMAN, S. G., MCMULLAN, A. V., and GRIGGS, ROSAMOND, *Isolation of an active substance from* Calonyction aculeatum *capable of coagulating castilla latex*. Science 97: 471–472. May 21, 1943.

## BOTANY.—Dipterocypsela, *a new genus of Vernonieae from Colombia*.[1] S. F BLAKE, Bureau of Plant Industry, Soils, and Agricultural Engineering.

A composite from a little-known area in interior Colombia, referred to me for study by E. P. Killip, of the U. S. National Herbarium, proves to represent a new genus of Vernonieae with somewhat remarkable features of involucre, corolla, and achene.

**Dipterocypsela** Blake, gen. nov.

Capitula homogama discoidea multiflora. Involucri hemisphaerici phyllaria ca. 3-seriata gradata, extima parva linearia subherbacea saepe cornuta, media oblonga submembranacea margine subscariosa plusminusve concava apice cucullata dorso infra apicem herbaceo-cornuta, intima ovata submembranacea plana inappendiculata. Receptaculum planum nudum. Corollae irregulares 5-fidae, fauce campanulata tubum subaequante, limbo bilabiato, labio exteriore e dentibus 2 longioribus, interiore e dentibus 3 brevioribus constante. Antherae apice appendicibus ovatis praeditae, basi alte sagittatae, auriculis obtusis ecaudatis, eis contiguis connatis. Styli rami anguste linearisubulati hispiduli. Achenia (immatura) late ovalia valde obcompressa saepius bialata, facie interiore 4-costata exteriore 3-costata, alis (una vel ambabus) saepe in cornua productis. Pappus pluriseriatus gradatus fragilis deciduus e setis numerosis hispidulis compositus.—Herba elata succulenta apice bifurcata inconspicue pilosula pilis appressis; folia ampla late ovata repande paucidentata (suprema integra) penninervia sicc. membranacea olivaceoviridia longe petiolata petiolis supra alatis; capitula mediocria numerosa in spicis scorpioideis longis nudis pedunculatis basi interruptis axillaribus v. extra-axillaribus et terminalibus disposita; corollae purpureae. Species typica *D. succulenta*, sp. nov.

**Dipterocypsela succulenta** Blake, sp. nov.

Herba 2.5 m alta, basi invisa, partis novellis cinerascentibus. Folia inferiora magna, petiolo 9–20 cm longo infra nudo supra cuneate alato, ala interdum 1–2-dentata, lamina late ovata ca. 30 cm longa et lata acuta basi subtruncata vel obscure cordata paucidentata et inter dentes vix evidenter multidenticulata dentibus venulas terminantibus obtusis glandulosis inter se saepius 1.5–3.5 mm distantibus penninervia nervis 8–10-jugis apice curvato-anastomosantibus albidis; folia media minora, basi rotundata; folia suprema multo minora integra v. subintegra, petiolo 1.5–4.5 cm longo, lamina 7.5–11.5 cm longa, 5.5–8.5 cm lata. Pedunculi saepius 5.5–9 cm longi; spicae 8–30 cm longae, duabus terminalibus equalibus v. inaequalibus. Capitula ca. 26-flora basi lata sessilia ebracteata ca. 1 cm diam. 7 mm alta, vel florentia

[1] Received December 14, 1944.

(sicca) ca. 20 mm diam. 8 mm alta. Phyllaria extima ca. 5 anguste linearia ca. 4 mm longa 0.5 mm lata laxa apice saepe breviter herbaceo-cornuta vel cucullata; media ca. 4 oblonga ca. 6.5 mm longa obtusa submembranacea dorso viridescentia margine et apice subscariosa plusminusve concava apice saepe cucullata infra apicem cornu dorsali obtuso molliter herbaceo recte patente donata; intima ca. 4 late ovata ca. 8 mm longa, 4.5 mm lata, obtusa apice paullum erosa submembranacea dorso viridescentia margine et apice subscariosa

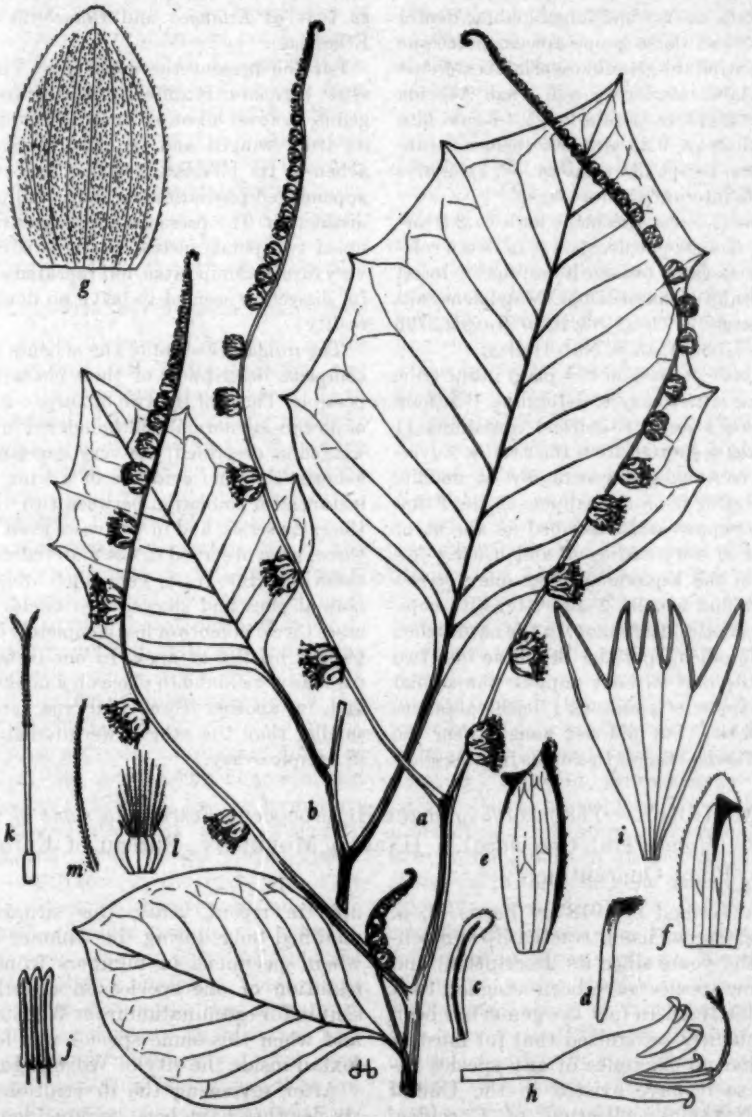


FIG. 1.—*Dipterocypsela succulenta*, from the type: *a*, Apex of plant, ×½; *b*, upper part of stem, ×½; *c*, *d*, phyllaries of outermost series, ×5; *e*, *f*, phyllaries of middle series, ×5; *g*, phyllary of inmost series, ×5; *h*, corolla in side view, ×5; *i*, corolla spread out, ×5; *j*, 3 stamens, ×5; *k*, style, ×5; *l*, achene, ×5; *m*, pappus bristle, ×10.

paene ad apicem breviter ciliata ut phyllaria cetera dense cinerascenterque pilosula pilis appressis; omnia margine et apice saepe purpureo-tincta. Corollae purpureae ca. 8 mm longae, saltem exteriores horizontaliter patentes tubo stamineo et stylo sursum curvatis; tubus tenuis ca. 2.5 mm longus glaber; faux campanulata ca. 2.5 mm longa glabra; dentes apice recurvati dorso prope apicem praecipue juventate stipitato-glandulosi, ei labii exterioris 3 mm ei labii interioris 2 mm longi. Achenia valde immatura ca. 1 mm longa 1.5 mm lata (alis tenuibus ca. 0.25 mm latis inclusis) truncata glabra. Pappi albi setae ca. 56, exteriores ca. 1.5 mm interiores 3 mm longae.

COLOMBIA: Erect succulent herb to 2.5 meters high, flowers purple, showy, in dense colonies on masses of broken limestone in forest 5 km south of Codazzi, Dept. Magdalena, alt. ca. 150 meters, 31 Oct. 1943, *Oscar Haught* 3796 (type no. 1708581, U. S. Nat. Herb.).

The proper position of this plant in the tribe Vernonieae is not easy to determine. Bentham and Hooker's series Ethulieae, containing 11 genera, was separated from their series Euvernonieae, containing 6 genera, by no definite character aside from the pappus. In the Ethulieae the pappus was described as absent or composed of very caducous and usually few bristles, in the Euvernonieae as more or less persistent and usually 2–3-seriate, with copious inner bristles. Hoffmann, in Die natürlichen Pflanzenfamilien, split the Ethulieae into two groups, the first without pappus, the second with a pappus of caducous ("leicht abfallenden") bristles, but did not assign them the dignity of series names. In this, as in some similar cases in other groups of Compositae, it is not too easy to discriminate between a caducous pappus, one that is fragile and readily deciduous, and one that is definitely persistent. Moreover, some species of *Vernonia* and related genera of the Euvernonieae possess a pappus that is quite as fragile and as readily deciduous as that of *Erlangea* and *Blanchetia* (of the Ethulieae).

For the present the genus may be placed after *Vernonia*. It differs primarily from that genus, as from all other known Vernonieae, in its truly winged and strongly obcompressed achenes. Its bilabiate corollas and curiously appendaged phyllaries are additional points of distinction. The presence of an outer lip made up of two petals instead of three is certainly very rare in Compositae, but repeated and careful dissection seemed to leave no doubt of its reality.

The immature state of the achenes makes a complete description of their characters impossible. Those of the two or three outer series of flowers are normally although not invariably winged as described; the very immature inner achenes show no evidence of a wing. Several instances of connation between two ovaries of the same series, and in two cases even between three, were observed in the material dissected; these immature fruits were much broader than normal ones and showed two circles (in two cases three) of more or less completely detached pappus bristles at apex. In one instance two corollas were found in place on a double ovary, and in another three embryos, one much smaller than the others, were found in place in a triple ovary.

## ENTOMOLOGY.—*The mealybug genus* Heterococcus *Ferris and some of its relatives (Homoptera: Coccoidea).*[1] HAROLD MORRISON, Bureau of Entomology and Plant Quarantine.

First described in 1918 by Ferris (4, p. 65), *Heterococcus* has attracted little attention in the years since its description, and only a few species have been assigned to it during this time. In fact the genus has been so infrequently recognized that for most of this period no examples of any species belonging to it have existed in the United States National collection of Coccidae. While a few specimens have become available in recent years, this situation was modified only during the summer of 1944, when specimens in numbers from an infestation of one species on timothy were sent in for examination from Wooster, Ohio, and when this same species was found on foxtail inside the city of Washington, D. C.

After reviewing the descriptions of the species that have been assigned here, it appears reasonably certain that this recently collected insect is undescribed, and since it has been reported from an important forage

[1] Received December 11, 1944.

plant, the name and description here presented may prove useful to economic entomology. At the same time a review of the other species assigned to the genus is attempted, although this, of necessity, is based mostly on literature and not on actual specimens of the species involved and so undoubtedly possesses the deficiencies of work so based. Through the much appreciated courtesy of Prof. G. F. Ferris, it has been possible to examine a specimen from the type material of the genotype, *Heterococcus arenae* Ferris, and supplementary descriptive notes and figures for this species, as well as a broadened generic diagnosis, thereby have been added to the paper. The illustrations accompanying the paper were drawn by Mrs. Sara Hoke DeBord.

## GENERIC RELATIONSHIPS OF HETEROCOCCUS

There exists at present so much confusion respecting the characteristics and limits of the various genera that have been described among the mealybugs that any suggestions or conclusions that may be offered in this restricted study must be accepted as tentative or preliminary. Professor Ferris in his initial presentation of this genus stressed the combination of the characters 9-segmented antennae, tarsal claw with denticle, and presence of circular pores only in the dorsal derm as a basis for generic recognition. With some additions and elaboration these still seem to present the most significant characteristics of the group of species involved.

To anyone who has examined numbers of mealybugs, the outstanding characteristic of this genus surely will be the numerous circular multilocular disk pores, normally quinquelocular, that are distributed widely over both surfaces of the body and that appear obviously to represent an alternate to the small trilocular (and usually triangular) disk pores that may be called a normal feature of mealybug anatomy. These circular pores are so distinctive that they must have some classificatory significance, and on this account consideration has been given to certain other mealybugs that are known to possess them in comparable striking fashion. Possibly additional species in the mealybug group beyond those discussed should be considered, but many of the specific descriptions are too incomplete to permit accurate recognition of their relationships.

First in line for consideration is one of the species originally described in the genus *Heterococcus*, *H. painei* Laing (15, p. 20). This species, while conforming with some elements of the original generic characterization, is described as lacking any definite indications of cerarii, such as the paired spines on the anal lobes of the genotype, and as possessing a single transverse ventral cicatrix (or circulus), a structure not found in any of the species here considered to belong properly in the genus. The stout oval body of *painei* and its very different habitat, on coconut in the South Pacific, also contribute to the conclusion that it would be best to exclude the species from *Heterococcus*. On the basis of present imperfect knowledge of mealybug generic standards, a new genus for this species would seem to be indicated and is described in this paper.

A second species in which the quinquelocular pores are numerous and conspicuous, and which possesses other characteristics of *Heterococcus*, as 9-segmented antennae, cerarian spines, and denticulate claw, is the one described as *Pseudococcus flagrans* by Brain (3, p. 140). Although it is so similar to *Heterococcus*, it became evident, in the process of checking literature, that *flagrans* is congeneric with and closely related to *Annulicoccus ugandensis* James (13, p. 209), having the same 9-segmented antennae, the same row of four ventral cicatrices down the ventral abdominal midline, and, from James's illustration, an even greater abundance of large quinquelocular and smaller multilocular disk pores. Surprisingly, however, while James in his generic discussion states flatly that the claw lacks a denticle, this, as indicated above, is definitely present, and sometimes almost conspicuous, in specimens of Brain's species. From examination of many species in the so-called *Phenacoccus* series of mealybug genera it has seemed that the presence of a claw denticle (usually in association with 9-segmented antennae) was positively significant as evidence of a segregation group including several genera. Even if the presence or absence of a claw denticle is actually without classificatory significance in *An-*

*nulicoccus*, the genus certainly seems to be a sound morphological and ecological segregate with the two species here associated in it.

The presence of more or less enlarged, circular, usually quinquelocular pores has been reported for several species of *Ripersia*, but, so far as has been ascertained, only one of these, *Ripersia asphodeli* Bodenheimer (1, p. 178) appears to approach *Heterococcus* in respect to the abundant development and very wide distribution of the quinquelocular pores. In this species, on the basis of specimens supplied by Dr. Joseph Carmin, the large quinqueloculars (many actually are quadrilocular, or sometimes even trilocular) are heavily distributed over the body, especially along the margin and towards the apex of the abdomen, there is a distinct claw denticle, apical cerarii are developed and no ventral cicatrix or circulus is present. To this extent the insect is very strongly suggestive of *Heterococcus*, but the antennae are reduced to six segments, a few normal, small trilocular, pores are present, chiefly in the developed cerarii, and there are none of the large multilocular disk pores which occur in most of the species of *Heterococcus*. The situation of this species seems to be comparable to that of *H. painei*, already discussed, in that its characteristics, on the basis of our present knowledge of mealybug generic standards, appear to entitle it to segregation in a distinct generic unit; certainly it stands out as sharply as *Brevennia* and *Lacombia* separated from *Ripersia* as subgenera by Goux (10).

Accordingly, it has seemed best, in spite of the fragmentary character of this study, to establish a new genus for this anomalous species.

These various genera, so far as our present knowledge goes, may be separated from all other described mealybugs by the presence in the derm, both dorsally and ventrally, of numerous, circular, usually quinquelocular (but the loculi may range from three to six or more) disk pores, these occupying the place of the characteristic small trilocular pores of most mealybugs, with the triloculars either wanting entirely or greatly restricted in numbers and distribution.

The key below is offered for the separation of the four genera under discussion.

### Genus **Annulicoccus** James

*Adult female.*—Thinly coated with white secretion, without cerarian tassels, body color pinkish, size medium (length 2–4 mm), elongate elliptical, length more than twice width, wholly membranous. Antennae 9-segmented, as in *Heterococcus*. Eyes approaching hemispherical, with only a small asymmetrical sclerotized base. Legs a little thickened, an obscure pattern of widely scattered tiny pores more or less developed on femur and tibia, these lacking on coxa, claw with or without denticle, tarsal digitules slender, acute, attaining or exceeding claw apex, claw digitules slender, slightly knobbed apically, slightly exceeding the claw apex. Beak very short conical, incompletely 2-segmented. Spiracles not unusual, with both quinqueloculars and multiloculars associated with each. Dorsal ostioles developed, not conspicuous, lips with some pores and setae. Cerarii not sharply developed, superficially with only the apical two or three pairs obvious, these each with two (rarely one) lanceolate spines and numerous rather long and stout setae and quinquelocular-type pores associated; actually (at least in *flagrans*) with 16 or 17 pairs of cerarian structures, each, except posterior as stated,

#### Key to Heterococcus and Associated Genera

*a.* One or more ventral cicatrices present.

*b.* A single transverse ventral cicatrix; no traces of cerarii, not even one or a pair of slender spines in any cerarian area; multilocular disk pores few, restricted to midventral areas of last three segments ..... *Laingiococcus*, n. gen.

*bb.* Four conspicuous, circular to transversely elliptical ventral cicatrices in a row down ventral midline of abdomen; definitely recognizable cerarian spines present, on anal lobes at least; multilocular disk pores much more abundant, in wide bands on ventral surface of posterior abdominal segments and in irregular rows dorsally; quinquelocular-type pores distinctly larger than multiloculars ..... *Annulicoccus* James

*aa.* No ventral cicatrices present.

*c.* Antennae normally 9-segmented; no trilocular (triangular) pores present; multiloculars usually present, lacking in one species ..... *Heterococcus* Ferris

*cc.* Antennae 6-segmented; a few trilocular pores present in cerarii and widely scattered elsewhere; multiloculars lacking ..... *Asphodelococcus*, n. gen.

with a single slender, lanceolate spine and several setae and quinquelocular-type pores. Anal lobes not developed, at most a faint bulge, no ventral thickening or any sclerotized area. Anal ring approaching the normal pseudococcine type, but the outer pores definitely circular in shape, loosely arranged in middle of row, bunched at ends, pores of inner row more tightly bunched throughout, this row shorter than outer; with six setae, the longest a little shorter than apical anal lobe seta. Four types of derm pores present, all in numbers: Large quinquelocular-type with range of four to six or even nine loculi, multiloculars, here smaller than the quinquelocular-type, much smaller short tubulars, expanded at inner ends, and finally very tiny, short, cylindrical, simple pores; no normal triloculars and no normal elongate, slender tubulars. Body setae numerous on both surfaces, varying strongly in size, stiff basally but tapering to delicate tips. Characteristically four circular to transversely stout elliptical ventral cicatrices, posterior smallest, located on the midline seemingly in the interspaces between the second to sixth segments.

*Type of genus.*—*Annulicoccus ugandensis* James (13, p. 209).

The preceding description has been based, in part, on specimens of the second species included, that is, *flagrans* (Brain), since the description of *ugandensis* omits mention of a few of the characters considered.

The two species now included may be separated by the following key:

*a.* Claw without denticle; large quinquelocular-type pore described as actually with 6 to 9 loculi ..... *ugandensis* James

*aa.* Claw with distinct denticle; quinquelocular-type pore actually normally with 5 loculi. *flagrans* (Brain)

The preceding discussion and the accompanying illustrations (Figs. 6, 14–21) of *flagrans*, drawn from specimens from Brain's type material, should serve not only to fix the generic characters clearly but also to present descriptive details beyond those provided by Brain in his original description of this species (3, pp. 140–143).

**Asphodelococcus,** n. gen.

*Adult female.*—Secretionary covering uncertain, body color pink, size medium, length around 3 mm, elliptical, wholly membranous. Antennae 6-segmented, apical segment much longer than any other and with four sensory setae. Eye somewhat rounded and on a flat, asymmetrical, basal collar. Legs normal but small and a little thickened, posterior without pores on coxa or femur, a few scattered on tibia, claw denticle distinct, tarsal digitules acute, not exceeding claw apex, claw digitules faintly knobbed apically, surpassing claw apex. Beak stout conical, wider than long, incompletely 2-segmented. Spiracles not unusual. Both pairs of dorsal ostioles present. Only the posterior two or perhaps three pairs of cerarii plainly developed and recognizable, but others along the body margin vaguely indicated, developed cerarii including slender spines, trilocular pores, and spinelike accessory setae, smaller than spines, but otherwise hardly differentiated. Anal lobes indicated by rounded bulges, no ventral thickening, apical setae of moderate length. Anal ring approaching normal pseudococcine type, with two rows of pores on each half, and with six setae, the longest a little shorter than apical seta. Three types of pores present, normal small triloculars scattered in small numbers, large quinquelocular-type, with three to six loculi, very numerous and crowded, and small tubular ducts with inner ends thickened and swollen and externally protruding openings; no multiloculars. Dorsal body setae small, almost spinelike, scattered, inconspicuous in midst of pores, ventral considerably longer and more slender, but few and likewise inconspicuous. No ventral cicatrix.

*Type of genus.*—*Ripersia asphodeli* Bodenheimer (1, p. 178).

This is the only species at present known to possess any close approximation to the above combination of structural characters. From literature, *Lacombia* Goux (10, p. 62), based on the species *Ripersia bouhelieri* Goux (9, p. 199), possesses certain characteristics indicating possible relationship, since it lacks multilocular disk pores, but does have triloculars, quinqueloculars, and tubular ducts with protruding openings. However, there is no evidence from the description that the quinqueloculars occur in abundance as with this genus, the apical antennal segment is not so conspicuously elongated, there is no claw denticle, the body setae are comparatively very numerous, the anal ring is unusual, with the pores in the bands reduced in size and mostly widely separated, no cerarii are developed, and at least one ventral cicatrix is present. Certainly it is preferable to let these two stand as independent generic units until

much more knowledge on mealybug classification has accumulated.

The following descriptive details on the species *asphodeli* are supplementary to those given above in the generic description, and both should be used together for specific recognition.

**Asphodelococcus asphodeli** (Bodenheimer)

Fig. 1–5, 7–13

*Adult female.*—As mounted, elongate elliptical, maximum observed length 3.25 mm, width 1.6 mm. Antennal segments in microns: I, 40–44; II, 36–40; III, 44–48; IV, 18–20; V, 23–24; VI, 64–70 (four antennae); preapical segment with a single long, slender, somewhat curved sensory seta in addition to the four similar ones on the apical segment. Lengths of parts of a posterior leg in microns: Trochanter, 52; femur, 112; tibia, 100; tarsus, 68; claw, 17; tarsal digitules, 20; claw digitules, 20; a few large indistinct areolae on coxa, pores on tibia 12–16; small, widely scattered; leg setae small, stiff. Observed beak dimensions: Length 62–72$\mu$, width 76–80$\mu$, with proportions maintained. Spiracles stout, but not enlarged, the bar with wide sclerotized extensions; posterior a little larger than anterior; a definite pore cluster around the opening of each spiracle, including 2–5 small triloculars immediately adjacent to outer margin of opening and a much larger number (25–50) of quinquelocular-type pores around three sides. Each dorsal ostiole centered in a roughly circular dermal area, of considerable size, free of the large quinquelocular-type pores; pore and setal association with the individual lips variable, from one tiny trilocular pore to as many as six, and from usually no setae to an observed maximum of two small, stiff ones. Only the two posterior pairs of cerarii sharply defined, each comprising two slender, faintly lanceolate spines about 19$\mu$ long, perhaps 12–15 (apical) or 6 to 10 (penultimate) small triloculars and around five short, stiff setae of varying sizes, some hardly distinguishable from the paired spines, all loosely grouped in a marginal area of appreciable size devoid of the large quinquelocular-type pores; other abdominal segments with suggestions of cerarian development involving similar rather distinct cleared areas and one to several small spines or setae plus a few small triloculars; parallel obscure hints at cerarian development anteriorly, but here intermingled directly with the large quinquelocular-type pores, not in cleared areas. With a very small, irregular, sclerotized area around the bases of the cerarian spines of the anal lobe, apical seta about 120$\mu$ long, ventral subapical about 42$\mu$. Anal ring small, the pores in the outer row approximately circular, separated by interspaces except at ends; pores in inner rows irregular in shape, crowded; longest and ring seta about 105$\mu$. Trilocular pores around 3.5$\mu$ in diameter, quinqueloculars around 7$\mu$, internal length of tubular ducts about the same, these with a short, cylindrical, external collar and a considerably longer membranous, somewhat tapering extension, together approximating a little more than half the internal length of the duct. The few scattered dorsal setae with an observed length range of 9–16$\mu$, the longer ventral setae ranging up to 43$\mu$.

This redescription is based on mounted examples of the species, collected by Dr. Joseph Carmin at Tel-Aviv, Palestine, April 12, 1927, prior to the date of publication of the original description of the species. Examiners of both this and the original description will find some discrepancies between the two, notably in the measurements of the antennal segments; all such divergences have been rechecked on the material studied, and statements here presented are believed accurate for this material.

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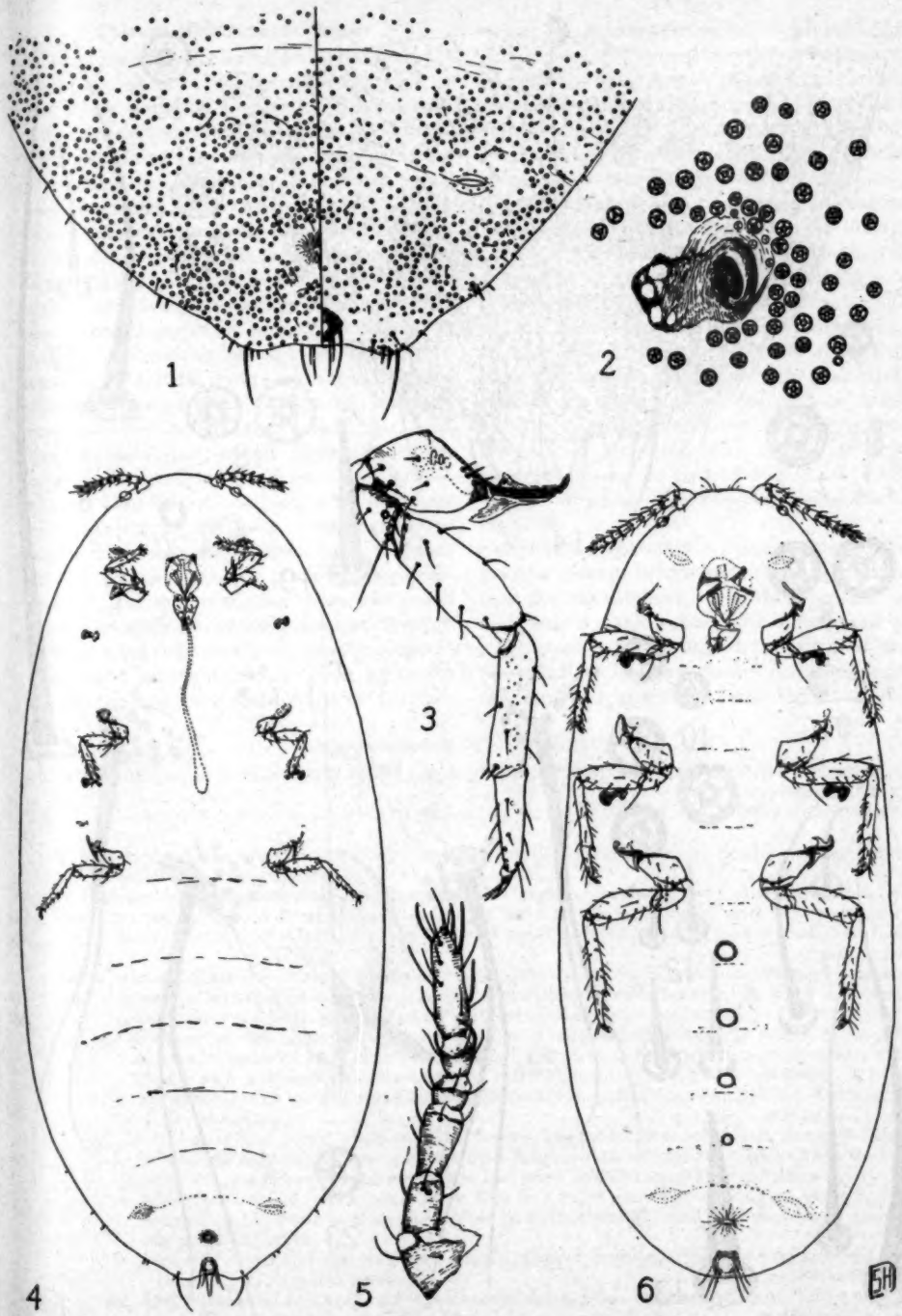
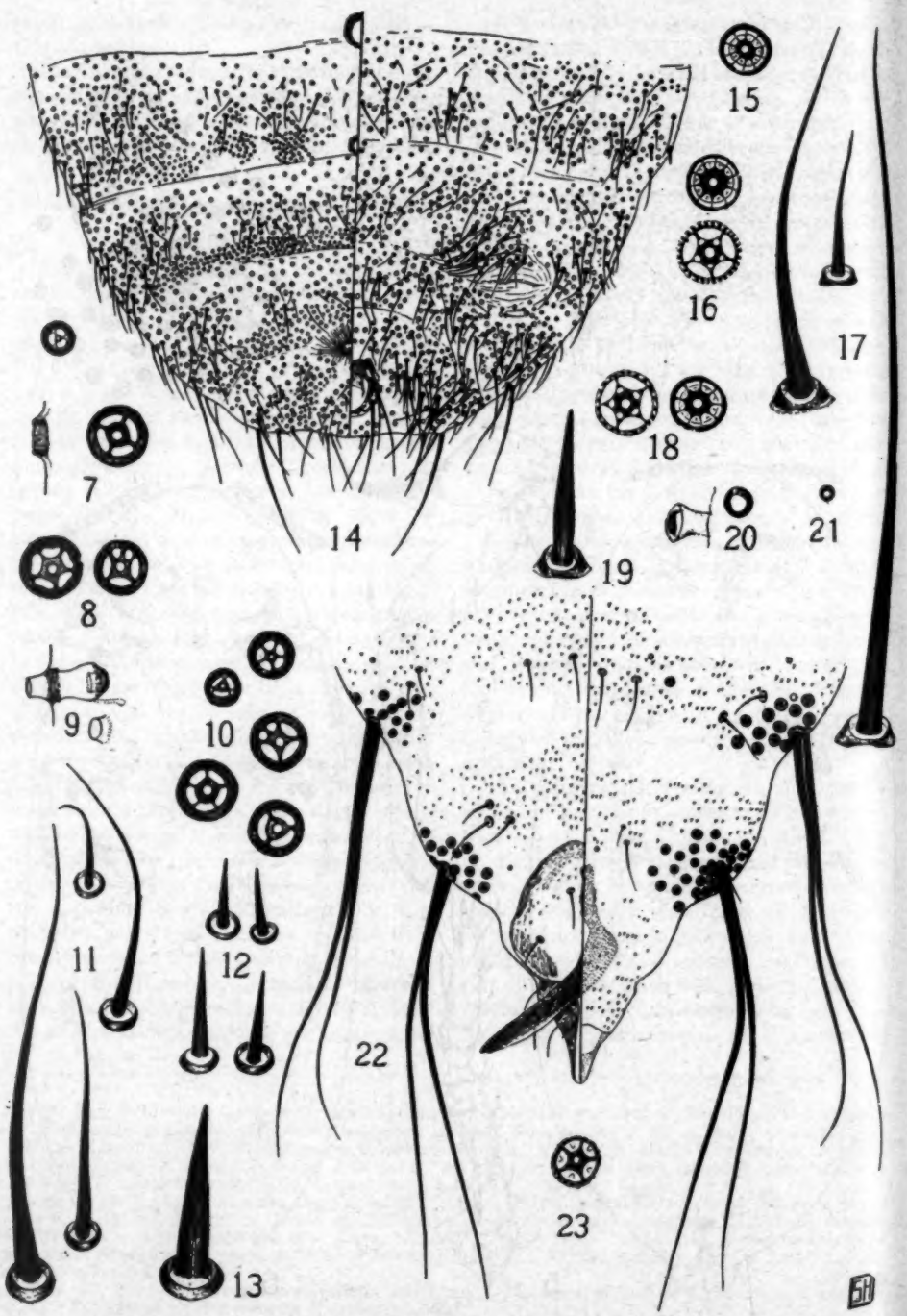
FIGS. 1–5, 7–13.—*Asphodelococcus asphodeli*, adult female: 1, Apex of abdomen, dorsal and ventral, ×115; 2, posterior spiracle with associated pores, ×460; 3, posterior leg, ×230; 4, body, optical section, ×50; 5, antenna, ×230; 7, disk pores in spiracular area, ×1,500; 8, ventral disk pores, ×1,500; 9, tubular duct, ×1,500; 10, dorsal disk pores, ×1,500; 11, ventral setae, showing size variation, ×1,500; 12, dorsal setae, ×1,500; 13, single cerarian spine, ×1,500.

FIGS. 6, 14–21.—*Annulicoccus flagrans*, adult female: 6, Body, optical section, ×50; 14, apex of abdomen, dorsal and ventral, ×115; 15, multilocular disk pore from spiracular area, ×1,500; 16, ventral multilocular and quinquelocular disk pores, ×1,500; 17, body setae, ×1,500; 18, dorsal multilocular and quinquelocular disk pores, ×1,500; 19, cerarian spine, ×1,500; 20, tubular duct, ×1,500; 21, minute simple pore, ×1,500.

FIGS. 22, 23.—*Heterococcus graminicola*, adult male: 22, Apex of abdomen, dorsal and ventral, ×650; 23, disk pore from cerarius of same, ×1,500.




FIGS. 1–6.—(See opposite page for explanation.)




FIGS. 7–23.—(See p. 42 for explanation.)

## Genus Heterococcus Ferris

*Adult female.*—Occurring on Gramineae, beneath leaf sheaths, accompanied by more or less white secretion and thinly coated with white powder. Size medium (length 1.5–3 mm), varying strikingly according to maturity of the individual; elongate elliptical to almost parallel-sided, length usually more than twice width. Membranous throughout. Antennae characteristically 9-segmented, the joint between eighth and ninth rigid and often incomplete or lacking; one slender sensory seta on seventh, one on eighth, three on ninth. Eyes circular in outline, approaching hemispherical, each on a small asymmetrical base. Legs normal, a little thickened, no pores on hind coxae, but tiny ones scattered on hind femora and tibiae; claw denticle developed; tarsal digitules slender, acute, not exceeding claw apex, claw digitules slender, slightly knobbed apically, definitely exceeding claw apex. Beak short conical, incompletely 2-segmented. Both pairs of dorsal ostioles present, the lips more or less ornamented with quinquelocular pores and small setae. Definitely recognizable cerarian development at most restricted to the posterior two to four pairs, and the cerarii, even here, not sharply defined, the association of the two spines, quinquelocular pores, and spinelike setae loose and sometimes even indistinct; existence in some species of additional cerarii on anterior abdominal segments and especially on head above eyes more or less suggested but not clearly evident. Anal lobes at most rounded bulges, apical seta definitely developed on each, no ventral thickening. Anal ring of normal pseudococcine type, with six setae, the longest a little shorter than apical seta, and inner and outer rows of pores on each half. Several pore types developed among included species though not all present on each, these including quinquelocular disk, large multilocular disk, tiny clear circular disk, and slender tubular duct. Dorsal body setae small, inconspicuous, varying from slender to almost spinelike; ventral setae slender, averaging much longer, all varying much in size. No ventral cicatrix.

*Type of genus.*—*Heterococcus arenae* Ferris (4, p. 65).

Although no attempt is made at this time to provide generic descriptions for stages other than the adult female, since these are known from only a single species, the descriptions of the first-stage larva and adult male that are presented for the new species described later from timothy and other hosts should supply

### KEY TO SPECIES OF HETEROCOCCUS

*a.* Multilocular disk pores wanting; cerarii not developed, cerarian spines represented only by slender setae ..... *biporus* (Goux)

*aa.* Multilocular disk pores present; at least the apical cerarii developed and usually with evidence of others.

*b.* Posterior cerarian spines tiny, perhaps one-sixth length of longest of 4 or 5 slender accessory setae associated in each cerarius ..... *nudus* (Green)

*bb.* Posterior cerarian spines much larger, at least half length of longest of associated accessory setae.

*c.* Cerarian spines and dorsal derm setae slender (see figures), tapering, at most only very faintly lanceolate; multilocular disk pores relatively few, restricted to vulvar area of ventral surface. *arenae* Ferris

*cc.* Cerarian spines and dorsal derm setae with obviously stouter proportions, definitely slender spinelike, often fairly distinctly lanceolate; multilocular disk pores much more numerous, present all along body margin and on both surfaces of the abdomen.

*d.* Multilocular disk pores more numerous in midabdominal area, dorsally fourth to seventh segments inclusive each with two rows, one complete and one interrupted medially, ventrally with a broken transverse row on third segment, an entire row on fourth, a band three pores wide on fifth, and numerous pores across sixth and seventh [*tritici* Kiritshenko of Borkhsenius] ..... *borkhsenii*, n. sp.

*dd.* Multilocular disk pores, while variable, fewer in midabdominal area, thus, dorsally fourth to seventh segments inclusive each with a single, often somewhat irregular and often incomplete row of pores, ventrally one or two pores on third, several on fourth in a medially interrupted single row, around 20 on fifth in a more narrowly interrupted single row, a continuous band two or three pores wide on sixth, a similar band on seventh, and numerous pores on eighth.

*e.* Anal lobe apical and anal ring setae normal, slender, long-tapering, lobe seta around 150$\mu$, longest anal ring seta around 96$\mu$ ..... *graminicola*, n. sp.

*ee.* Anal lobe apical and anal ring setae heavy, short, often bifurcate apically, lobe seta 68$\mu$ or less, anal ring setae less than 50$\mu$ ..... *occidentalis*, n. sp.

reasonably satisfactory evidence as to the structural characteristics to be expected for these stages in all the included species.

Thus far, five species have been described in or have been transferred to this genus. One of these, *painei* Laing, is made the type of a new genus in this paper. The remainder, together with two apparently undescribed species, are discussed below. All these have been reported from grasses (Gramineae) only.

Goux (8, p. 253), in connection with his description of the new species *biporus*, reduces *Heterococcus* Ferris to the status of a subgenus of *Phenacoccus* Cockerell, but from the present and other studies of mealybug classification it appears that the basic framework of a classification in the group is so poorly developed that there is little assurance that such a subordinate relationship presents a true picture. Accordingly *Heterococcus* Ferris is re-accepted in its original standing as a genus.

The foregoing key is offered for the separation of the species here included in the genus. No specimens of any of the three European species have been available for examination.

### Heterococcus arenae Ferris

Figs. 24–38

*Adult female.*—Elongate, sides nearly parallel, length 1.6 mm, width 0.55 mm, rounded tapering at anterior end, tapering posteriorly past the penultimate segment, then sharply constricted to the protruding anal segment. Membranous throughout. Antennae normally 9-segmented, maximum longitudinal dimensions of the segments in microns as follows: I, 32–36; II, 40; III, 28–32; IV, 20–22; V, 20; VI, 18–20; VII, 24; VIII, 24–26; IX, 35–38; last two segments incompletely separated in one antenna, combined length 60; sensory setae slender, curved, about 20$\mu$ long. Eye small, rounded, set on a comparatively large base, eye diameter about 16$\mu$, base about 33$\mu$. Posterior leg maximum longitudinal dimensions in microns: Trochanter, 60; femur, 120; tibia, 116; tarsus, 68; claw, 20; tarsal digitules, 20; claw digitules, 18–20; claw denticle sometimes obscure; pores on leg parts somewhat uncertain from specimen available, presented in figure as believed to occur. Beak somewhat distorted, apparent dimensions: Length 60$\mu$, width 72$\mu$. Bar of spiracle rather broadly sclerotized, a few scattered pores adjacent to opening. Lips of dorsal ostioles each with two to four quinqueloculars and posterior lip of anterior ostiole with two to three small setae in addition. Each apical cerarius recognizable as a combination of two slender spines about 18$\mu$ long, with a quinquelocular pore between them, and with a tiny, irregular, sclerotized area at base of one or more spines, and of a loose group of six to nine additional quinqueloculars and four to five stiff setae, hardly differentiated from the spines and 9–38$\mu$ long; the penultimate cerarian association is recognizable as two slender, well-separated spines, each being about 18$\mu$ long with a slightly closer association of the quinqueloculars around them; spines of other anterior cerarii probably present, but not clearly distinguishable through size, shape, or pore association. Anal lobes somewhat developed, rounded (the specimen probably recently molted), apical seta around 112$\mu$ long, subapical ventral 35–56$\mu$; no ventral thickening. Anal ring with longest setae about 84$\mu$. Body with numerous quinquelocular pores with average diameter about 5$\mu$, but varying somewhat, these approximately uniformly distributed both dorsally and ventrally, except on the intersegmental lines; a few multiloculars, each usually with 10 loculi and average diameter about 6.6$\mu$, on the underside of the abdomen, as follows in specimen examined: 16 behind vulvar opening, 17 in a loose cluster just anterior to vulvar opening, 4 on the next segment anterior; with a few slender, delicate tubular ducts about 10–11$\mu$ long, and somewhat varying in diameter, distributed over the body on both surfaces, some, at least, with opening on a protruding cone. Body setae small and inconspicuous dorsally, stiff but not spinelike, lengths from 4–12$\mu$ in middorsal area; ventrally much larger and more slender, lengths from 7–55$\mu$ in midventral area.

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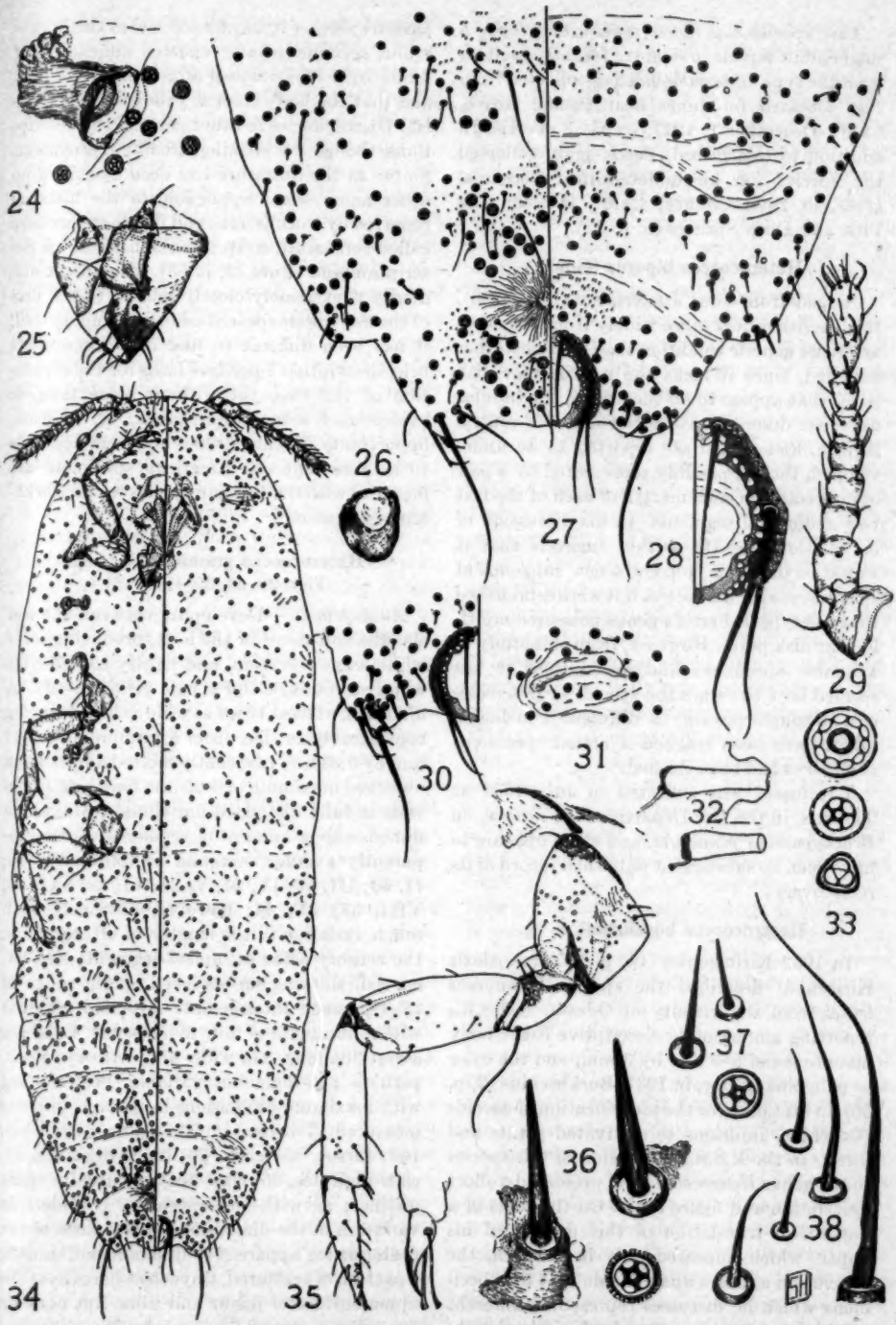
FIGS. 24–38.—*Heterococcus arenae*, adult female: 24, Posterior spiracle, ×460; 25, beak, ×330; 26, eye and tubercle, ×370; 27, apex of abdomen, dorsal and ventral, ×230; 28, anal ring, detail of right half, ×460; 29, antenna, ×230; 30, dorsal aspect of left anal lobe area, ×230; 31, anterior dorsal ostiole, ×230; 32, tubular ducts, one with protruding opening, ×1,500; 33, ventral disk pores, multilocular, normal quinquelocular and abnormal quinquelocular, ×1,500; 34, body, dorsal and ventral, showing pore distribution, ×87.5; 35, posterior leg, ×230, with detail of claw, ×650; 36, detail of cerarian spines, ×1,500; 37, dorsal setae and disk pore, ×1,500; 38, ventral body setae, ×1,500.




FIGS. 24–38.—(See opposite page for explanation.)

This species has been redescribed from a single adult female, evidently recently molted, from the type material labeled as collected from *Poa douglasii* on dunes near Pacific Grove, Calif., December 1, 1917, by G. F. Ferris. In addition to this record, Ferris again collected the species, on an undetermined perennial grass, in Inyo County, Calif., between Big Pine and Deep Springs (5, p. 22).

**Heterococcus biporus** (Goux)

Judged from Goux's description (8, p. 253), this species differs more widely from the characteristic generic condition than does any other included, since it lacks the multilocular disk pores that appear in all the others, the tubular ducts are described as restricted to the ventral surface, and cerarii are reported to be undeveloped, though possibly represented by a pair of long setae on each margin of each of the last two abdominal segments. In his discussion of its relationships the author suggests that it would be desirable to erect a new subgenus of *Phenacoccus* for his species if it were established that the type of Ferris's genus possessed multilocular disk pores. However, from this study of available specimens and descriptions it has seemed best to retain the species in *Heterococcus*, although possibly a different conclusion might have been reached if actual specimens of *biporus* had been studied.

The insect was collected in July 1934 at Tamaris, in the Var Department of France, on *Brachypodium pinnatum*, and there appears to have been no subsequent published record of its rediscovery.

**Heterococcus borkhsenii**, n. sp.

In 1932 Kiritshenko (14, p. 135) (as Alexis Kiricenko) described the species *Trionymus tritici* from the vicinity of Odessa, U.S.S.R., reporting among other descriptive items body dimensions of 8–9 mm by 3 mm, and the color as pale pink. Later, in 1937, Borkhsenius (2, p. 55), in his tables for the identification of coccids (Coccidae) injurious to cultivated plants and forests in the U.S.S.R., transferred this species to the genus *Heterococcus* and presented a short description and figure for it. On the basis of a noncritical translation of this portion of his paper, which appeared only in Russian, the conclusion appears unavoidable that the specimens which he discusses represent a different species from that described by Kiritshenko. As partial evidence it may be noted that the Borkhsenius specimens have reported dimensions of 2 mm by 1 mm, instead of 8–9 mm by 3 mm, and that the body color is yellowish, not pinkish. Discrepancies in other parts of the descriptions, though less striking, are likewise evident. So far as the literature has been examined no other name seems applicable to the material reported by Borkhsenius and it is therefore here called *borkhsenii*, n. sp., on the basis of his description and figure (2, p. 55). This insect evidently is extremely closely related to the first of the new species described below, and, indeed, it has been difficult to find in Borkhsenius's brief description a positive basis for the separation of the two, yet without some tangible evidence of actual interchange, or, at least, opportunity for this, it does not seem desirable to assume that our American specimens are identical with the Russian species which Borkhsenius discussed.

**Heterococcus graminicola**, n. sp.
Figs. 22, 23, 39–49, 51–61

*Adult female.*—Developing between the leaf sheaths and stems of the host, producing some white waxy secretion, and lightly coated with white secretion. Color a pale yellow. Body, as mounted, at least twice as wide as long, varying considerably in size, from a minimum of 1.41 mm by 0.53 mm in recently molted adults to an observed maximum of 3.25 mm long by 1.6 mm wide in fully distended individuals. Maximum dimensions in microns of segments of one, apparently average, antenna as follows: I, 36; II, 40; III, 32; IV, 21; V, 25; VI, 22; VII, 30; VIII, 37; IX, 44; however, obviously with much variation in the lengths of all segments; the sensory setae on apical segments slender, curved, showing an observed length range of 28–44$\mu$; each intermediate antennal segment with a minimum of four to five setae. Eye base about 36$\mu$ long, 24$\mu$ wide, and, with eye itself, perhaps 12$\mu$ high, but variable. Posterior leg with maximum dimensions in microns of parts measured: Trochanter, 73; femur, 170; tibia, 163; tarsus, 85; claw, 20; tarsal digitules, 24; claw digitules, 26; claw denticle usually quite distinct; as with the antennae, considerable variation in the dimensions of the parts of the posterior leg apparent in different individuals; a pattern of scattered, tiny, clear pores over the upper surface of femur and tibia, but none on coxa. Beak around 73$\mu$ long by 76$\mu$ wide, but

dimensions varying somewhat. Dorsal ostioles inconspicuous, especially on distended specimens, usually three to four quinqueloculars on each lip, and a single short, stiff seta on the posterior lip of each cephalic ostiole. The posterior three pairs of cerarii fairly plainly developed, and the fourth and fifth from the caudal apex often suggested by a pair of recognizable cerarian spines, the two spines in each pair usually distinctly separated, but appreciable variation occurring in the extent of development of all these cerarii; an average anal lobe cerarius including two faintly lanceolate spines around 17–22$\mu$ long, about 15–18 loosely grouped quinquelocular pores, and 3–6 stiff, short setae, differentiated from spines chiefly by smaller size; basic organization of the other evident cerarii including two spines and a few quinqueloculars, with the small setae really outside this association; a recognizable supraocular cerarius including, usually, three small spines and two or more quinqueloculars; organization of all cerarii, except anal lobe pair, tending to become obscured with body distension at maturity. Anal lobes suggested by rounded bulges in just molted adults, not evident in fully distended individuals; apical seta with maximum observed length 157$\mu$, ventral subapical 60$\mu$, and several smaller ventral setae from 16$\mu$ to 32$\mu$ long. Longest observed anal ring seta 100$\mu$. Derm pores and ducts numerous, quinqueloculars widely and fairly uniformly distributed over both surfaces except for intersegmental clear bands and areas occupied by multiloculars, diameter around 4$\mu$; multiloculars with diameter around 6–7$\mu$ and 10–12 loculi distributed in groups or rows dorsally, ventrally, and along margin, these groups conspicuous only in recently emerged adults, more or less obscured in fully distended individuals; numbers and groupings varying much from individual to individual, approximately as follows in one examined fully: Along margin, each side a cephalic group of 25 before antennal base, an ocular group of 5 or 6, a postocular of 17, about 5 scattered, a group opposite anterior coxa of 11, 2 scattered, a group opposite midcoxa of 8, 4 scattered, a group opposite posterior coxa of 7, first abdominal 6, second abdominal 3, third abdominal 12, fourth abdominal 15, fifth abdominal 20, sixth abdominal 36, seventh abdominal 46, last two practically continuous with ventral transverse rows of similar pores; dorsally with a scattered transverse row of 10 pores on abdominal segment III, of 17 on abdominal segment IV, of 20 on V, of 15 on VI, of 5 on VII; ventrally with 1 on III, 9 on IV, interrupted medially, 31 on V, 44 on VI, about 70 on VII, and about 65 on VIII; slender tubular ducts numerous ventrally, in one individual around 16 on underside of each anal lobe, around 66 across abdominal segment VII (prevulvar), around 98 across the next preceding (VI), around 71 on the next (V), and successively fewer on the anterior abdominal segments; apparently wholly absent on head and thoracic segments, much fewer dorsally on abdominal segments and likewise apparently absent on head and thorax, approximate length 9–10$\mu$, diameter at opening 1.7$\mu$, at inner end 2.1$\mu$; a very few tiny, flat, cylindrical pores without apparent internal structure, with diameter about 1.6$\mu$ visible both dorsally and ventrally. Dorsal setae not numerous, small and inconspicuous, stiff, almost spinelike, observed lengths varying from 3–6$\mu$ in the middorsal area, to 10$\mu$ toward margins; ventral setae slender, much longer, 12–36$\mu$ in midventral area and up to 44$\mu$ toward apex of abdomen.

*Larva.*—Elongate ovoid, length 0.52 mm, width 0.2 mm. Body membranous throughout, except a small, slender thickening from base of ventral subapical seta of each anal lobe. Antennae not unusual, dimensions of one in microns; I, 20; II, 20; III, 16; IV, 10; V, 12; VI, 56; three long sensory setae at apex of terminal segment, one on preapical. Eyes distinct, somewhat bulging, anterior margin of small, basal collar much wider than posterior. Legs not unusual, maximum lengths, in microns of parts of a posterior one: Trochanter, 32; femur, 64; tibia, 52; tarsus, 56; claw, 18; acute tarsal digitules, 24, faintly knobbed, slightly dissimilar, claw digitules, 18; claw denticle weakly developed but usually evident, sometimes obscure or wanting. Beak short conical, rounded apically, 40$\mu$ long by 44$\mu$ wide, incompletely 2-segmented. Spiracles small circles with slender tapering bar, a single quinquelocular pore outside each. Dorsal ostioles present, but obscure, especially the anterior. No complete cerarii developed, but a pair of enlarged spines on each side of anal ring, and additional pairs, reduced in size and the two spines more or less obviously associated, along the body margin to the cephalic apex, a total of 18 pairs evident and possibly homologous with the true cerarian

spines of species having these fully developed; individual quinquelocular pores more or less obviously associated with each spine pair. Anal lobes not developed, only a slight bulge on each side of anal ring; apical seta 76$\mu$, ventral subapical 28$\mu$, a small, irregular thickening about twice as long as wide extending forward from this. Anal ring normal, with 6 setae with maximum length around 40$\mu$. Only quinquelocular-type pores present, appearing as if in longitudinal rows on abdomen, middorsal about 2.4$\mu$ in diameter, laterals up to 4$\mu$. Setae tiny, almost spinelike, about 4$\mu$ in middorsal area, somewhat larger laterally and posteriorly, with anal lobe cerarian spines about 8$\mu$; ventral setae slender, maximum about 20$\mu$.

*Adult male.*—Fully developed, winged, thorax strongly sclerotized; body length (of one individual) 1 mm, width (through thorax) 0.26 mm. Head rounded from above, ventral surface more strongly sclerotized, this sclerotization continued dorsally on each side into an elongate triangular area enclosing the two upper eyes. Front of head, around and between antennae, and middorsal area between eyes somewhat less strongly sclerotized, bearing an irregularly elongate cluster of 10–12 tiny, simple pores above each antennal insertion, an irregular row of around 10 curved setae, each about 13$\mu$, on each side between upper eye and mid-line, and perhaps 15 longer curved setae, up to 22$\mu$, between antennal insertion and lower eyes; posterior portion of head membranous, transparent, bearing a cluster of 4–5 small setae (around 14$\mu$) dorsally on each side behind sclerotized area enclosing upper eye. Prothorax strongly transverse, anterior margin, and a triangular, posteriorly directed extension of this on each side, an irregular plate at posterior margin behind the anterior marginal areas, and coxal attachment piece all sclerotized; remainder of prothorax membranous; quinquelocular disk pores and small setae dorsally as in figure, a pair of quinqueloculars and two tiny simple pores between coxae, and a pair of setae with a tiny simple pore behind each coxa ventrally. Mesothorax and metathorax definitely sclerotized, shape and dorsal setae as shown in figure, length 280$\mu$, width 260$\mu$; wing shape and venation as in figure, surface thickly clothed with tiny hairs, with larger ones forming a marginal fringe, length 800$\mu$; halteres about 60$\mu$ long, elongate, somewhat enlarged about middle but with anterior margin irregular and incised at one or more points; a single apical seta, strongly recurved, at apex, length to apex of curve 48$\mu$. Legs moderately slender, each trochanter with three sensory pores on each face, each tarsus plainly 2-segmented, the basal ringlike, claw nearly straight, with small denticle on inner face about one-third of length from tip; leg setae stiff, but tapering to very slender apices, a pair of definitely enlarged, spinelike setae at apex of each tibia; lengths of parts of a hind leg in microns: Trochanter, 48; femur, 120; tibia, 162; tarsus, 84; claw, 27; slender tarsal digitules, 32; short, acute claw digitules, 5. Abdomen membranous throughout, except for apex and for one complete transverse sclerotized band just behind scutellum and one to three additional, medially interrupted and obscure, on the one to three segments immediately following that bearing the complete band; arrangement of dorsal quinquelocular and tiny disk pores and setae (about 22$\mu$) about as shown in figures; ventrally with a transverse row of from four to eight setae (about 16$\mu$) across the midline of the segments, and with a marginal cluster, characteristically of three to four setae, a single quinquelocular and a single tiny disk at each margin of the segments anterior to the cerarii; two pairs of cerarii, each cerarius with two long (156$\mu$), slender setae, a close cluster of quinquelocular pores (anterior around 24, posterior around 46), two to four tiny disk pores, and usually just outside the pore cluster

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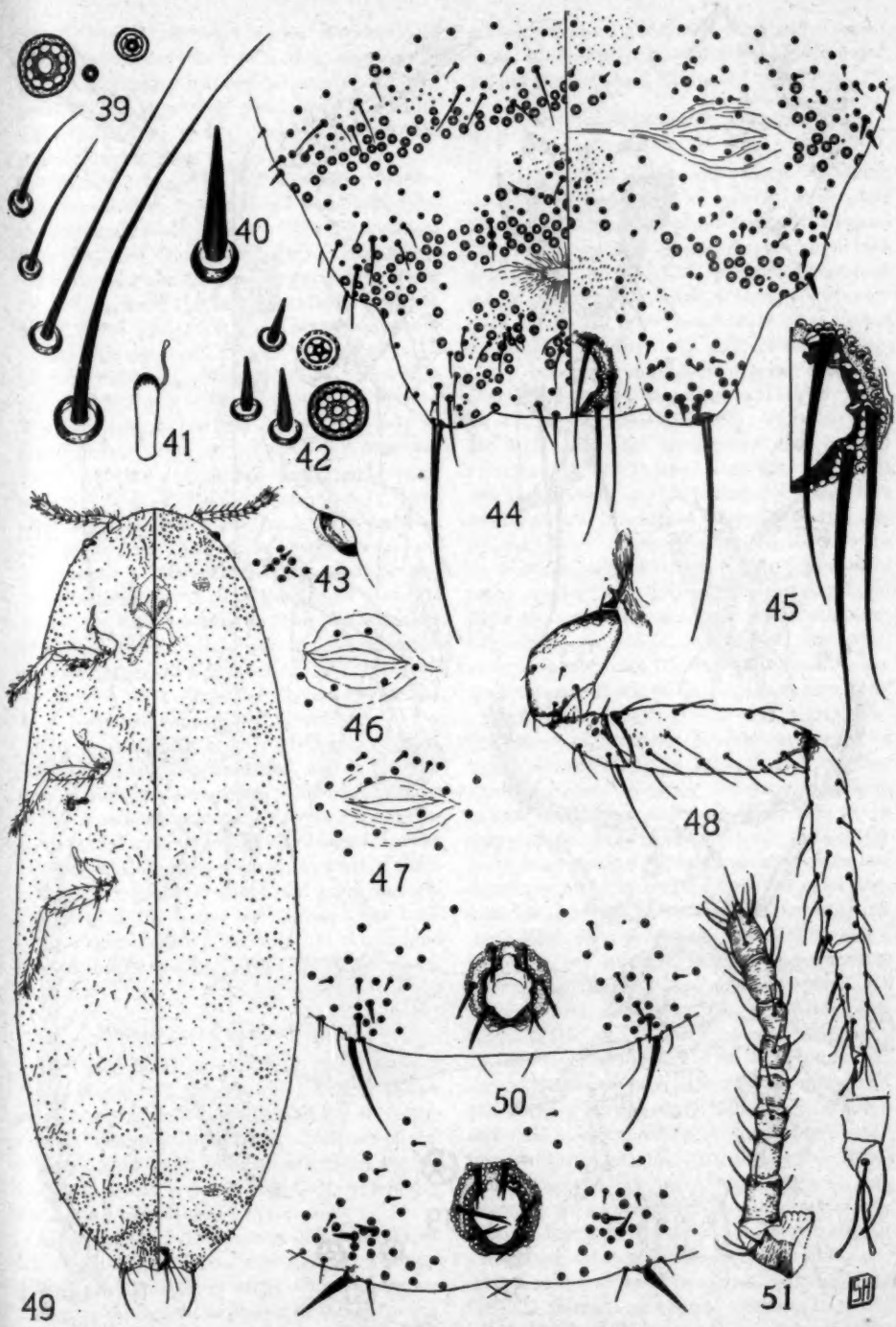
FIGS. 39–49, 51, 54.—*Heterococcus graminicola*, adult female: 39, Ventral setae and disk pores, ×1,500; 40, cerarian spine, ×1,500; 41, tubular duct, ×1,500; 42, dorsal setae and disk pores, ×1,500; 43, eye and adjacent supraocular cerarius, ×370; 44, apex of abdomen, dorsal and ventral, ×230; 45, anal ring, right half, ×460; 46, anterior and 47, posterior dorsal ostioles, ×230; 48, posterior leg, ×230, with detail of claw, ×650; 49, body, dorsal and ventral, with distribution of pores, ×50; 51, antenna, ×230; 54, beak, ×330.

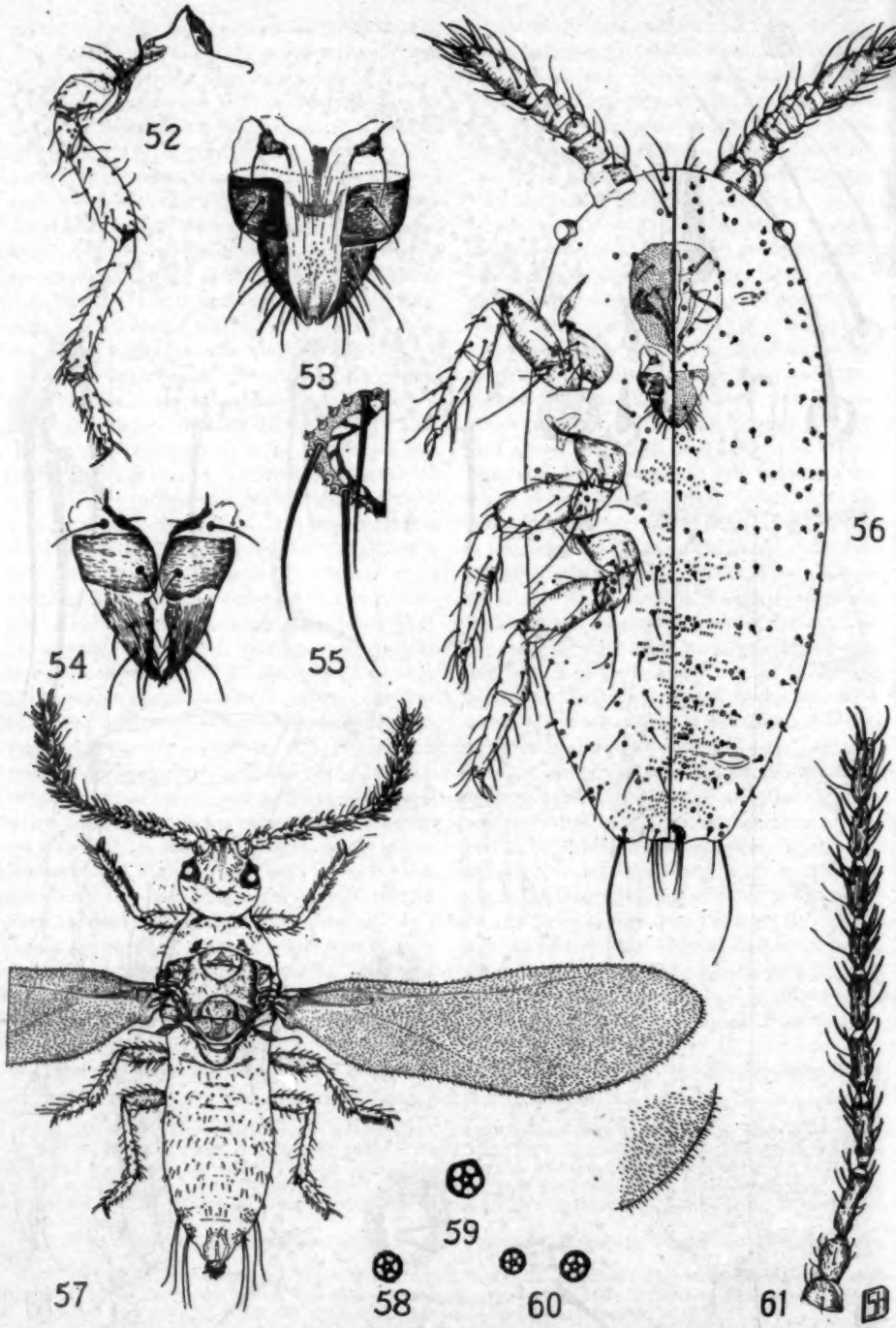
FIG. 50.—*Heterococcus occidentalis*, adult female, apices of abdomen, dorsal of two individuals, ×230.

FIGS. 52, 57–61.—*Heterococcus graminicola*, adult male: 52, Posterior leg, attachment plate and halter, ×165; 57, body, dorsal, ×87.5, with detail of wing margin, ×165; 58, ventral disk pore, ×1,500; 59, marginal disk pore, ×1,500; 60, dorsal disk pores, ×1,500; 61, antenna, ×165.

FIGS. 53, 55, 56.—*Heterococcus graminicola*, first stage larva: 53, Beak, ×650; 55, anal ring, left half, ×825; 56, body, dorsal and ventral, ×230.




FIGS. 39–51.—(See opposite page for explanation.)




FIGS. 52–61.—(See p. 50 for explanation.)

two to five slender setae; genital capsule at apex of abdomen about 100$\mu$ long, its protruding tip with expanded conical base about 36$\mu$; penis proper about 60$\mu$; penis directed diagonally downward, nearly straight except for slightly curved base.

This insect has been described from a number of specimens, mounted and unmounted, including material on timothy (*Phleum pratense*) from Wooster, Ohio, June, July, and August 1944, the first and last lots forwarded for study by J. S. Houser, the July lot collected by Dr. F. W. Poos (holotype and paratypes); from foxtail (*Setaria viridis*) from Washington, D. C. (Mount Pleasant section), August 13 and 20 and September 3, 1944, collected by Harold Morrison (paratypes and male allotype); in grass sheaths, from Fort Lee, N. J., May 24, 1938, collected by George Rau (paratypes); and on *Poa* sp., Portland, Oreg., May 12, 1944 (No. 16271) collected by George C. Anderson and James Roaf. In addition, specimens on Fescue grass from State College, Pa., October 25, 1941, collected by Keil, although all preadult stages, are considered to be this species, as are adult females on *Festuca rubra* in field, collected at State College, Pa., in 1942 by Keil (received through G. F. Ferris). The types are in the U. S. National, collection of Coccidae.

The relationships of this species have been indicated in the key to species, and in the discussion under *Heterococcus borkhsenii*. The New Jersey specimens examined are very similar to the material from Ohio; the specimens from the District of Columbia seem to average a little lower with respect to numbers of pores on various parts of the body, but no basis has been found thus far for a suspicion that they might be specifically distinct from the Ohio specimens.

### Heterococcus nudus (Green)

First described in 1926 (11, p. 172) as a *Phenacoccus*, this species was transferred two years later by its author (12, p. 21) to *Heterococcus*. The only subsequent references of significance that have come to attention are by Goux (6, p. 332; 7, p. 63; 8, p. 256), who found the species in southern France.

Assuming the full accuracy of all details of the original description and figures, we may distinguish the species easily from others included in the genus, as shown in the key.

Green's specimens came from undetermined grasses taken at Camberly, England; Goux's, from *Holcus lanatus* collected at Courzieu, Rhone Department, France.

### Heterococcus occidentalis, n. sp.

Fig. 50

*Adult female.*—Very similar to *graminicola* in size and organization of pores, ducts, and setae but differing sharply in respect to appearance and dimensions of anal ring and anal lobe apical setae, these in all specimens examined much shorter and much stouter in appearance than with *graminicola*. Size as mounted up to 2.93 mm by 1.63 mm; elongate elliptical, broadly rounded at ends. Antennae characteristic, lengths of one in microns: I, 40; II, 44; III, 36; IV, 23; V, 24; VI, 23.6; VII, 28; VIII, 32; IX, 44; sensory seta on VII often curved and twisted, that on VIII about 28$\mu$ long, those on IX about 24$\mu$ long. Eye with outside dimensions of base around 24$\mu$ by 8$\mu$. Legs characteristic, posterior with an obscure pattern of tiny clear pores as in other species, and with maximum lengths of parts of one in microns as follows: Trochanter, 64; femur, 153; tibia, 140; tarsus, 84; claw, 19.5; tarsal digitules, 21; claw digitules, 20; claw denticle present but often inconspicuous. Beak characteristic, length of one 68$\mu$, width 72$\mu$. Spiracles characteristic. Dorsal ostioles quite inconspicuous. Usually only the apical two pairs of cerarii definitely recognizable, spines in anal lobe cerarii about 17$\mu$ long, with 10–12 quinqueloculars adjacent, and one to two stiff body setae associated; penultimate cerarii less developed, and cerarian traces on next two anterior segments of abdomen rather obscure. Anal lobes not developed, apical seta short, usually heavy, observed length range from 44$\mu$ to a maximum of 68$\mu$, ventral subapical seta likewise stout, about 28$\mu$ long, perhaps six additional scattered ventral setae, approximating 16$\mu$ in length. Anal ring with setae short, observed maximum 40$\mu$, many between 30$\mu$ and 36$\mu$, some of normal shape, but many flattened and split apically, as if composed of two setae fused together for most of their lengths. Quinqueloculars widely distributed, general distribution of multiloculars as in *graminicola*, along margins and dorsally and ventrally in abdominal area; numbers very variable, observed range of total marginal multiloculars 120–225, dorsal and ventral about as in *graminicola*, but variable; small tubulars similar,

but somewhat fewer. Body setae likewise similar, observed range of middorsal 5–10$\mu$, maximum observed midventral 24$\mu$, all somewhat stiffer than with *graminicola*.

This species is based on a few mounted and unmounted specimens collected August 28, 1940, on grass at Yakima, Wash., by F. W. Carlson. These are so very close to *graminicola* that a decision was made to describe them only after long consideration. The extraordinary condition of the anal ring and anal lobe setae surely is due, in part at least, to molting difficulties of some sort at the time of change from preadult to adult, but this would not with certainty account for all the differences that appear in these structures, since the few in the material examined that approximate normal condition are likewise much shorter and stouter than corresponding structures in *graminicola*.

The types are in the U. S. National collection of Coccidae.

**Laingiococcus**, n. g.

*Adult female.*—Appearance in life uncertain. Broad elliptical, flattened dorsally and ventrally, posterior apex broadly notched. Size medium, length 2 mm; derm membranous throughout. Antennae 9-segmented, apical segment short, not enlarged, with two sensory setae, preapical with one. Eyes developed. Legs not unusual, claw with distinct denticle, tarsal digitules acute, not attaining claw apex, claw digitules longer, extending well beyond tip of claw, knobbed at apices. Beak described as 1-segmented. Spiracles not unusual. Dorsal ostioles described as absent. No cerarii of any sort developed, at most with evident clusters of large body setae on margins of terminal abdominal segments. Anal lobes broadly rounded protrusions, apical seta not differentiated. Anal ring removed from the body apex, appearing dorsal, presumably with six setae, each half narrow, apparently with a single pore row. With circular quinquelocular pores on both surfaces, and multilocular disk pores on posterior abdominal segments. Body setae numerous, some large, stiff, some small, slender. A single transversely elliptical ventral cicatrix.

*Type of genus.*—*Heterococcus painei* Laing (15, p. 20).

The preceding description has been based entirely on the description of the genotype (15). Laing's placement of this species in *Heterococcus* has been accepted as the starting point for its reassignment to a related new genus, but it should be noted that the description contains certain discrepancies which, if verified, may prove barriers to the assumed close relationship. Thus the described absence of doral ostioles and of all traces of cerarii, the occurrence of an unsegmented beak (perhaps a question of interpretation of structure), and (from its illustration) the narrow anal ring with only a single pore band all depart widely from the basic pseudococcine structure exhibited by the other genera here discussed.

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## ENTOMOLOGY.—*A new genus and twelve new species of Neotropical whiteflies (Homoptera: Aleyrodidae).*[1]

LOUISE M. RUSSELL, Bureau of Entomology and Plant Quarantine. (Communicated by C. F. W. MUESEBECK.)

This paper treats the pupae of an interesting new genus of Aleyrodidae that is widely distributed in the Antillean Subregion of the Neotropical Region but that is unknown elsewhere. Members of the group appear to be somewhat restricted in their host associations, for each available species is recorded from only one plant genus, and several of those at hand are known from a single species of plant. Such geographical and host limitations doubtless will be somewhat modified by additional collecting, however. Two species described here, from *Malpighia* and *Stigmaphyllon*, respectively, were received for identification. Ten species were collected from herbarial specimens of *Coccoloba* by Marjorie J. Camp, Bureau of Entomology and Plant Quarantine, through the courtesy of the persons in charge of the Arnold Arboretum, the Gray Herbarium, the New York Botanic Garden, and the United States National Herbarium. In the collection data for the species from *Coccoloba* the names of the herbaria are abbreviated; the name of the plant collector is given when known. Type specimens are in the collection of the United States National Museum.

### Crenidorsum, n. gen.

The genus *Crenidorsum* is composed of both similar and diverse species, with intergrading forms between the extremes of the group. Little variation has been observed in the characters which separate the species, and the most closely related forms are amply distinct from one another. The genus appears to be most closely allied to three genera established by Quaintance and Baker, *Aleuroplatus*, *Aleurotrachelus*, and *Aleurotulus*, and superficially at least it resembles *Aleuropuleus* and *Laingiella*, both erected by Corbett for Oriental species. *Crenidorsum* can be distinguished from these and other genera by the following combination of characters: A somewhat longitudinal, differentiated line consisting of a row of scallop-shaped thickenings, or a ridge, or a furrow, in inner subdorsum (for terminology see Russell, Proc. Ent. Soc. Washington **45**: [131]–132, 1943) on each half of body; those intersegmental sutures lying between differentiated lines terminating mesad of lines; vasiform orifice subcordate to broadly elliptical, its sides apparently without minute spines and not continued forward to form the bottom of the orifice; operculum nearly or actually filling orifice, not recessed posteriorly; lingula appearing jointed near the center, expanded distally but not transverse, with an apical notch; submedian cephalic setae present; submargin not separated from dorsal disk; without median abdominal disk pores, a complete submarginal or subdorsal row of setae, or a tubercle between caudal setae.

*Generic description.*—Body somewhat oval, flat to slightly convex dorsally, flat ventrally. Brown or black and heavily sclerotized, or colorless and membranous.

Body margin weekly to strongly dentate. Anterior and posterior marginal setae present. Ridges extending mesad from margin. Submargin not separated from dorsal disk, not deflexed.

A somewhat longitudinal, differentiated line consisting of a row of scallop-shaped thickenings, or a ridge, or a furrow, in inner subdorsal area of cephalothorax and abdomen, on each half of body. A submedian pair of cephalic, eighth abdominal, and caudal setae. Three subdorsal pairs of minute setae on thorax and 1 anteriorly on abdomen. Transverse molting suture extending laterocaudad from its midpoint, curved cephalad slightly mesad of, and

[1] Received November 11, 1944.

continued at least to, differentiated lines; its center approximately three times as far from mesometathoracic suture as from thoracoabdominal one. Intersegmental sutures between differentiated lines terminating mesad of lines; cephalothoracic and promesothoracic sutures curved posteriorly. Median length of cephalic segment greater than that of thorax; pro-, meso-, and metathorax subequal; abdominal segments 1–6 subequal. Pockets rather small, not contiguous. Pairs of submedian depressions arranged as follows: Three on cephalic segment (1 or 2 mesocephalad and 0 or 1 mesad of setae, and 1 posterior to setae near suture), 2 small or 1 large in cephalothoracic suture, 1 on prothorax, 1 in promesothoracic suture, 1 each on meso- and metathorax, 1 adjoining posteriorly thoracoabdominal and each abdominal suture; cephalothoracic and posterior abdominal ones often rather faint. Vasiform orifice subcordate to broadly elliptical, located approximately its length from posterior suture and at least its length from body margin; its sides minutely ridged vertically, apparently without minute spines, slightly converging near base but nearly vertical, not continued forward to form the bottom of the orifice; rim of orifice rather thick. Operculum nearly or actually filling orifice, not recessed; ventrally covered with minute spines, a pair of small setae near center. Lingula somewhat linear near base, narrowed and appearing jointed near the center; gradually expanded distally, but not transverse, with an apical notch; longer than orifice but lying in a curved position and contained in it; a pair of minute lobes bearing a pair of small setae, near base of expanded area; a pair of elongate setae arising ventrally just before apex; covered with minute spines. Caudal furrow broad, shallow. Caudal ridges (ridges laterad of either or both the vasiform orifice and caudal furrow) present.

Tracheal folds defined. Spiracles small, thoracic and anterior abdominal pair nearly as large as posterior pair, the latter slightly posterior to widest part of orifice. Antenna reaching to anterior spiracle; distal eighth narrowed, covered with minute spines, a sensorium at base and a seta at apex. Two minute setae just before disk of each leg, one just before these, and at least one on inner basal area of each middle and posterior leg. One pair of adhesive sacs. Male organ apparently a simple (not bifid) sac.

Genotype, *Crenidorsum tuberculatum*, n. sp.

### Key to Species of Crenidorsum

1. Minute spines absent ventrally; submedian cephalothoracic and eighth abdominal setae either about 14$\mu$ long and somewhat nail-shaped, or about 6 or 100–125$\mu$ long and slender, not stout at base in relation to length (Figs. 5, 18, 20) ..... 2

   Minute spines present ventrally; submedian cephalothoracic and eighth abdominal setae 30–60$\mu$ long, somewhat conical, stout at base in relation to length (Figs. 22, 30) .. 9

2. Derm brown or black and heavily sclerotized; a row of large scallop-shaped thickenings in inner subdorsum, terminating on abdominal segment 7; submarginal teeth present; minute setal bases present, located mesad of scallops; submedian cephalothoracic and eighth abdominal setae somewhat nail-shaped (Fig. 5) ..... 3

   Derm colorless and membranous; a row of small scallop-shaped thickenings, or a ridge with scallops suggested, or a furrow without a suggestion of scallops, in inner subdorsum, each terminating before abdominal segment 7; submarginal teeth apparently absent; minute setal bases absent; submedian cephalothoracic and eighth abdominal setae tapered from base to tip (Figs. 18, 20) ..... 7

3. Outer side of ridge over scallops densely sclerotized and tending to be divided into somewhat rectangular, transverse plates with a plate over each scallop, rows of minute, stout spines running lengthwise of each plate (Figs. 10, 11); submedian depressions and intersegmental sutures unusually conspicuous, deep, dotted and bordered with minute irregular areas and minute spines (Fig. 10); marginal teeth about twice as long as wide, about 15 in 100$\mu$; 3 pairs of subdorsal minute setae on cephalic segment. *ornatum*, n. sp.

   Outer side of ridge over scallops, and submedian depressions and intersegmental sutures not as in *ornatum;* marginal teeth not or only slightly longer than wide, no more than 13 in 100$\mu$; 0 or 1 pair of subdorsal minute setae on cephalic segment .. 4

4. Outer disk pores subdorsal in position, the majority approximately three times the width of a marginal tooth from submarginal teeth (Fig. 3); a well-defined median tubercle on each of abdominal segments 2–6 (Fig. 1); 1 pair of outer subdorsal minute setae on cephalic segment. *tuberculatum*, n. sp.

   Outer disk pores submarginal in position, the majority no more than the width of a marginal tooth from submarginal teeth; median tubercles absent, or well-defined only on abdominal segments 2–5; no subdorsal minute setae on cephalic segment ..... 5

5. Two pairs of subdorsal disk pores on posterior segment, 0 just laterocaudad of vasi-

form orifice (Fig. 12); majority of outer disk pores the width of a marginal tooth from submarginal teeth; most marginal teeth slightly longer than wide, approximately 13 in 100μ.....*commune*, n. sp.

Three pairs of subdorsal disk pores on posterior segment, 1 pair just laterocaudad of vasiform orifice; majority of outer disk pores at ends of submarginal teeth; most marginal teeth at least as wide as long, approximately 10 in 100μ.....6

6. A median tubercle on each of abdominal segments 2–5; ends of body broadly curved, the posterior end as broad as the anterior end and nearly straight in the center; caudal setae as near to body margin as to vasiform orifice.....*malpighiae*, n. sp.

No median tubercles on abdomen; ends of body less broadly curved, the posterior end narrower than the anterior end and curved in the center (Fig. 13); caudal setae about one-third nearer to vasiform orifice than to body margin.....*armatae*, n. sp.

7. (2) Differentiated inner subdorsal line consisting mostly of small scallops (Fig. 14); submedian mesothoracic setae present, these and other submedian setae about 6μ long. *leve*, n. sp.

Differentiated inner subdorsal line either a ridge or a furrow, without distinct scallops; submedian mesothoracic setae absent, or these and other submedian setae at least 100μ long.....8

8. Differentiated inner subdorsal line a low distinct ridge sclerotized on its outer side (Fig. 17); submedian setae approximately 100–125μ long, mesothoracic pair present (Fig. 16); 0 submedian disk pores on first abdominal segment, 1 inner subdorsal pair on meso- and metathorax (Fig. 16). *differens*, n. sp.

Differentiated inner subdorsal line a narrow furrow sclerotized on each side (Fig. 19); submedian setae approximately 6μ long, mesothoracic pair absent (Fig. 21); 1 pair of submedian disk pores on first abdominal segment, 2 inner subdorsal pairs on meso- and metathorax (Fig. 21). *marginale*, n. sp.

9. (1) Derm membranous, colorless; submedian meso- and metathoracic setae absent, cephalic ones about 40μ long, and 8μ in diameter at the base, eighth abdominal ones about 30μ long, and 6μ in diameter at the base; rows of scallops terminating on abdominal segment 6 (Fig. 29). *diaphanum*, n. sp.

Derm sclerotized, brown or black; submedian meso- and metathoracic setae present, these, cephalic, and eighth abdominal ones about 60μ long, and 14–20μ in diameter at the base; rows of scallops terminating on abdominal segment 5.....10

10. Ridges extending inward from submarginal furrow of ventral surface except in tracheal folds and beside abdominal tracheal fold; a band of minute spines reaching from ridges to submedian area, also present across tracheal folds (Fig. 26); a tongue-shaped projection extending inward from collar around each submedian cephalothoracic seta (Fig. 28); 20–26 scallops in each row.....*stigmaphylli*, n. sp.

Ridges extending inward from submarginal furrow of ventral surface much less numerous than in *stigmaphylli*, or absent; minute spines much less numerous or arranged differently than in *stigmaphylli*; no tongue-shaped projection extending inward from collar around submedian cephalothoracic seta; 26–36 scallops in each row.....11

11. Ventral surface with ridges extending mesad from submarginal furrow on cephalic segment and on abdominal segments 2–4; minute spines in a band starting near median line anteriorly, and terminating before ventral abdominal setae, mesad of ridges (Fig. 25); a rather deep invagination in anterior margin of vasiform orifice (Fig. 24); caudal setae considerably farther apart than eighth abdominal ones.....*debordae*, n. sp.

Ventral surface without ridges; minute spines along tracheal tract from anterior edge of thoracic tracheal folds to anterior abdominal spiracles (Fig. 23); a relatively shallow invagination in anterior margin of vasiform orifice; caudal setae as far apart as eighth abdominal ones.....*magnisetae*, n. sp.

### Crenidorsum tuberculatum, n. sp.

Figs. 1–5

White, cottony, waxy material extending outward from submargin in contiguous strands about one-third as long as width of body; similar strands also extending from inner subdorsum to body margin; a few flecks of white, waxy material scattered mesad of strands. A layer of transparent, colorless wax present ventrally, rather thick at margin, thin elsewhere.

Body broadly oval, ends broadly curved, posterior end nearly straight in center; slightly narrowed on pro- and mesothorax, widest across metathorax and first abdominal segment; 0.75–1.10 mm long and 0.60–0.85 wide. Brown to black, heavily sclerotized.

Marginal teeth strong, close-set, their sides converging slightly and their apices broadly curved, slightly longer than wide, 3 or 4 at each tracheal pore area often slightly smaller than others, slightly variable in width, approximately 10 in 100μ. Submarginal teeth located slightly mesad of marginal ones, weak, light colored, netlike in appearance. Each marginal seta about 28μ long.

Ridges extending from margin to inner subdorsum, as wide as a marginal tooth in submargin, at least twice that width in subdorsum. An inner subdorsal row of 24–30 strong, heavily sclerotized, scallop-shaped thickenings; 1 or 2 scallops smaller and mesad of others (sometimes poorly defined) on cephalic segment, rows slightly and evenly curved from cephalothoracic suture, terminating on abdominal segment 7; scallops nearly contiguous, the curved portion extending into the body cavity, the outer ends in derm and forming the basal part of the outer side of a rather sharp ridge extending over scallops; scallops as long as height of ridge; outer side of ridge more heavily sclerotized than subdorsum, a membranous line at top of ridge. A subcircular or transverse, smooth, median tubercle near posterior edge of each of abdominal segments 2–6. A submedian pair of meso- and metathoracic setae present; these, cephalic, and eighth abdominal ones somewhat nail-shaped, about 14$\mu$ long; metathoracic ones located close to anterior edge of transverse molting suture, eighth abdominal pair cephalolaterad of vasiform orifice, midway between orifice and posterior suture; caudal setae tapered from base, about 6$\mu$ long, located on outer side or on top of caudal ridges, slightly nearer to body margin than to orifice, practically as far apart as eighth abdominal ones. The four pairs of subdorsal minute setae in central subdorsum, an additional pair in outer subdorsum on cephalic segment. Two inner subdorsal (mesad of scallops) pairs of minute setal bases on prothorax and 1 pair usually on each of abdominal segments 3–5. Inner margin of disk pores not circular, with 2–5 points, larger than associated porettes; pores arranged in a row about three times the width of a marginal tooth from submarginal teeth, about one-seventh as numerous as teeth; other pores in a row distad of and about one-half as numerous as scallops; an occasional pair between the rows and 3 or 4 central subdorsal pairs on cephalic segment; mesad of rows of scallops and an imaginary curved line extending from their ends to median line of body, pairs of pores arranged as follows: Cephalic segment, 1 submedian anteriorly and 1 near cephalothoracic suture, and 1 subdorsal; prothorax, 1 submedian and 2 subdorsal; meso- and metathorax, each 2 submedian and 1 subdorsal; first abdominal segment, 0; second, 1 submedian; third through fifth, and seventh, each 1 submedian and 1 subdorsal; sixth, 1 subdorsal and rarely 1 or 2 submedian pores; eighth, 1 subdorsal laterocaudad of eighth abdominal seta, 1 slightly posterior to widest part of orifice, and 1 just laterocaudad of orifice. Transverse molting suture terminating just outside scallops, its ends nearly opposite its center; a little transverse sculpturing along median molting suture; abdominal sutures 1–6 terminating just outside submedian area, their ends nearly straight; abdominal segment 7 one-half to two-thirds as long as segment 6; intersegmental sutures and submedian depressions moderately defined, the latter more distinct on abdomen than on cephalothorax. Vasiform orifice subcordate, the outer edge of its rim not, or barely defined anteriorly, but the inner edge of its rim defined around anterior end of orifice, measuring 48–62$\mu$ long and wide (including lip between rim and margin anteriorly and rim elsewhere, the former 4–6$\mu$ long and the latter 4–6$\mu$ thick); orifice slightly elevated, a depressed line along its sides, located about one and one-third times its length from body margin. Operculum filling orifice, with 2 longitudinal depressed lines and 1 or 2 transverse ones. Caudal ridges weak, extending from opposite orifice to caudal setae.

Ventrally a membranous furrow just within margin. Minute, slender, spine-shaped markings in abdominal tracheal fold. Ventral abdominal setae 24$\mu$ long.

*Type.*—U.S.N.M. 56965. Between Guayanilla and Tallaboa, Puerto Rico, from *Coccoloba.*

Described from 14 specimens collected from *Coccoloba obtusifolia* Jacq. in Puerto Rico; between Guayanilla and Tallaboa, plant collector

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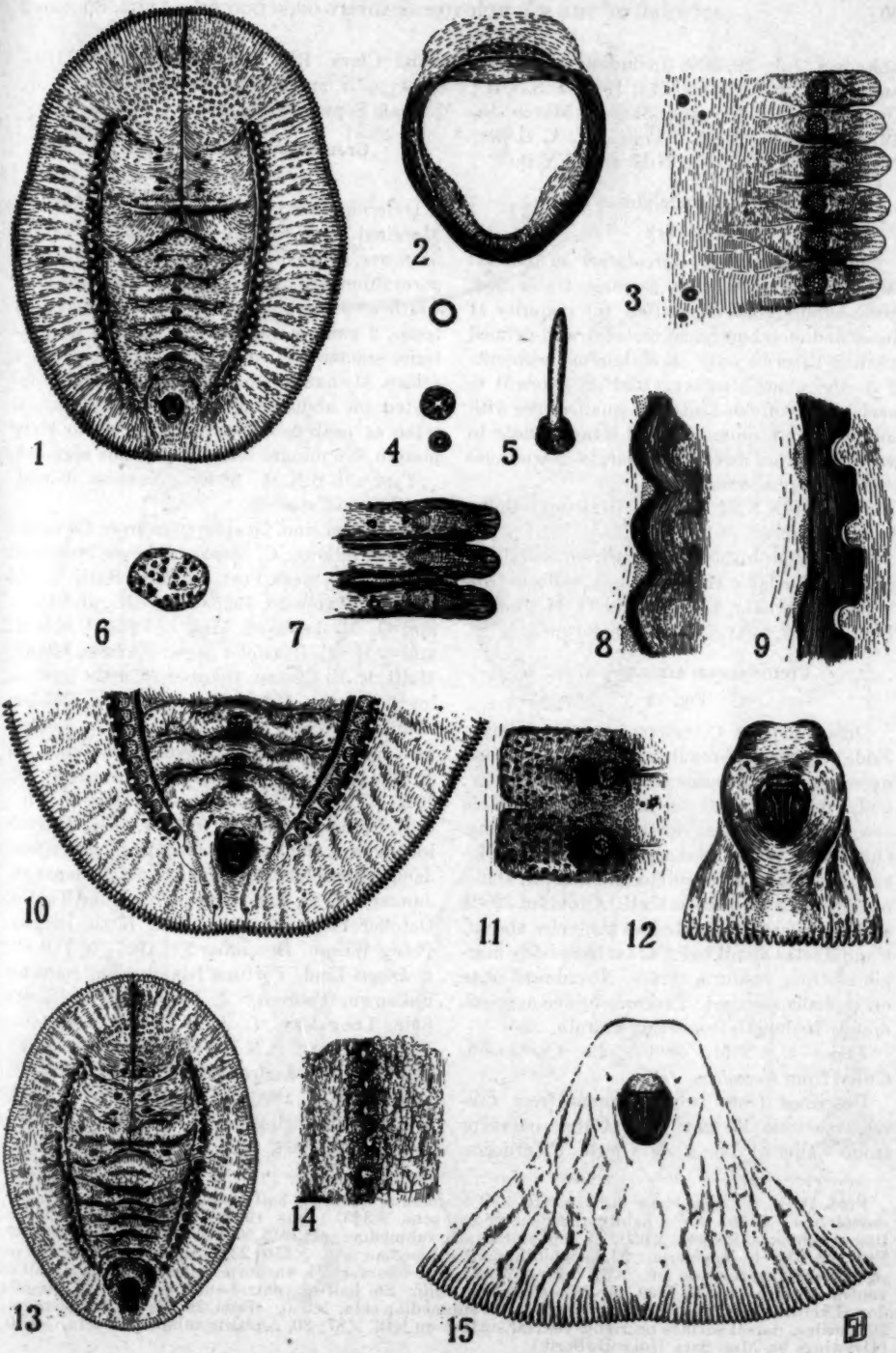
FIGS. 1–5.—*Crenidorsum tuberculatum:* 1, dorsum, ×87; 2, vasiform orifice, without operculum or lingula, ×530; 3, section of margin and submargin, ×650; 4, minute setal base, disk pore and porette, ×1,500; 5, cephalothoracic submedian seta, ×1,500. FIGS. 6–9.—*C. malpighiae:* 6, median tubercle, ×650; 7, section of margin and submargin, ×650; 8, subdorsal scallops, ventral view, ×650; 9, subdorsal scallops, dorsal view, ×650. FIGS. 10, 11.—*C. ornatum:* 10, posterior 4 segments, dorsal view, ×115; 11, plates above scallops, ×530. FIG. 12.—*C. commune,* posterior segment, dorsal view, ×165. FIG. 13.—*C. armatae,* dorsum, ×87. FIGS. 14, 15.—*C. leve:* 14, area around scallops, ×650; 15, posterior segment, dorsal view, ×165.




FIGS. 1–15.—(See opposite page for explanation).

unknown, July 29, 1886 (including, holotype), and J. A. Shafer, March 13, 1913, U.S.N.H.; Guayanilla, Britton and Shafer, March 10, 1913, N.Y.B.G.; west of Ponce, A. A. Heller, November 26, 1902, U.S.N.H. and N.Y.B.G.

**Crenidorsum malpighiae,** n. sp.

Figs. 6–9

Differing from *C. tuberculatum* as follows: Marginal teeth as wide as long. Outer disk pores submarginal in position, the majority at inner end of submarginal teeth. A well-defined median tubercle only on abdominal segments 2–5, one sometimes suggested on segment 6, each usually divided into 3–5 smaller ones with minute, stout spines. Caudal setae as near to vasiform orifice as to body margin. No minute setae on cephalic segment.

*Type.*—U.S.N.M. 56966. Habana, Cuba, from *Malpighia.*

Described from 30 specimens from *Malpighia glabra* L., Vedado, Habana, Cuba, collector unknown, February 4, 1919, and C. H. Ballou, February 23, 1921 (including holotype).

**Crenidorsum armatae,** n. sp.

Fig. 13

Differing from *C. tuberculatum* as follows: Ends of body less broadly curved, posterior end narrower than anterior end, curved in center; body not narrowed on thorax in available specimens. Marginal teeth as wide as long. Outer disk pores submarginal in position, located at inner end of submarginal teeth, about one-fifth as numerous as teeth. A total of 22–24 scallops in each row. Median tubercles absent. Caudal setae about twice as far from body margin as from vasiform orifice. No minute setae on cephalic segment. Vasiform orifice approximately its length from body margin.

*Type.*—U.S.N.M. 56967. La Carbonera, Cuba, from *Coccoloba.*

Described from two specimens from *Coccoloba armata* Wright, from Cuba; paratype from Calicito, Loma de Ciego, Cienfuegos, Santa Clara, Rob Combs, August 26, 1895, holotype from La Carbonera, Oriente, E. L. Ekman, September 23, 1914, U.S.N.H.

**Crenidorsum commune,** n. sp.

Fig. 12

Differing from *C. tuberculatum* as follows: Marginal teeth slightly more tapered, apices narrower, approximately 13 in 100$\mu$. Outer disk pores submarginal in position, the majority the width of a marginal tooth from submarginal teeth; 2 pairs of subdorsal disk pores on posterior segment, 0 just laterocaudad of vasiform orifice. Median tubercles absent, or barely suggested on abdominal segments 3–5. Caudal setae as near to vasiform orifice as to body margin. No minute setae on cephalic segment.

*Type.*—U.S.N.M. 56968. Navassa Island, Haiti, from *Coccoloba.*

Described from 30 specimens from *Coccoloba* spp., as follows: *C. bergesiana ovato lanceolata* E. Schmidt, near Port de Paix, Haiti, E. L. Ekman, March 26, 1925, U.S.N.H., and E. C. and G. M. Leonard, May 1, 1929, U.S.N.H. and G.H.; *C. laurifolia* Jacq., Navassa Island, Haiti, E. L. Ekman, October 23, 1928 (including holotype), U.S.N.H., and H. A. Rehder, January 6, 1930, A. A., and Baille La Lomas, near St. Michel de l'Atalaye, Department du Nord, Haiti, E. C. Leonard, November 26, 1925, U.S.N.H.; *C. uvifera* L., Miami, Fla., J. F. Collins, December 9, 1917, G.H. The following from the Bahama Islands: *C. diversifolia* Jacq., Rose Island, Britton and Millspaugh, January 27–28, 1905, Inagua, Nash and Taylor, October 11, 1904, West End, Little Inagua, Percy Wilson, December 21, 1907, N.Y.B.G.; *C. krugii* Lind., Fortune Island, plant collector unknown, February 2, 1888, road to South Side, Long Cay, L. J. K. Brace, December 7–17, 1905, U.S.N.H.; *C. laurifolia* Jacq., Nicolls Town, Andros Island, J. and A. Northrop, April 11, 1890, N.Y.B.G., edge of Mangrove Swamp, Hog Island, Britton and Brace, August 29, 1904, N.Y.B.G., Harbour Island,

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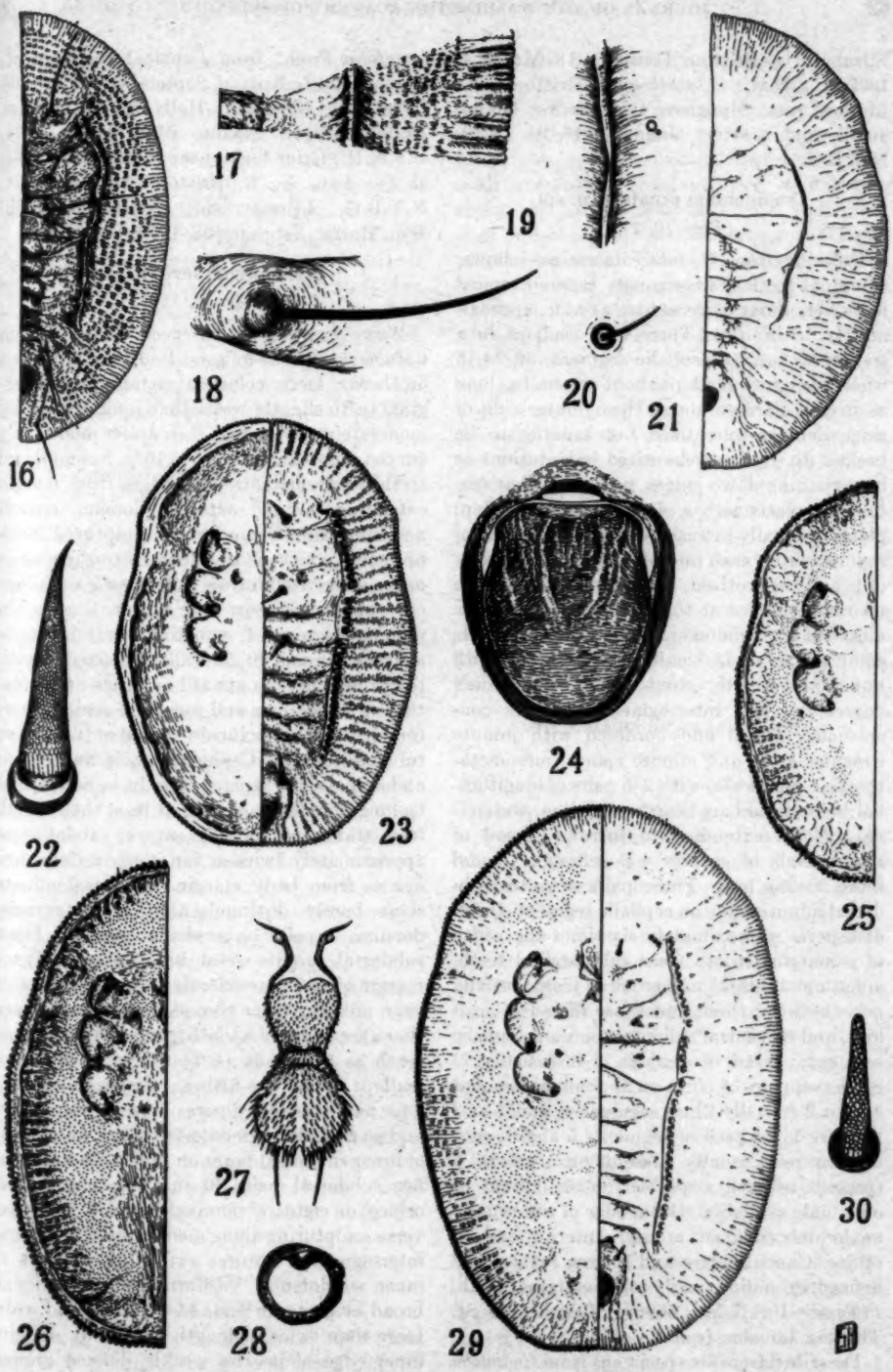
FIGS. 16–18.—*Crenidorsum differens:* 16, half of dorsum, ×87; 17, half of third abdominal segment, dorsal view, ×165; 18, cephalothoracic submedian seta, ×345. FIGS. 19–21.—*C. marginale:* 19, section of subdorsal furrow, ×650; 20, cephalothoracic submedian seta, ×1,500; 21, half of dorsum, ×87. FIGS. 22, 23.—*C. magnisetae:* 22, cephalothoracic submedian seta, ×650; 23, outline, dorsal surface on right, ventral surface on left, ×87. FIGS. 24, 25.—*C. debordae:* 24, vasiform orifice, ×650; 25, half of ventral surface, ×87. FIGS. 26–28.—*C. stigmaphylli:* 26, half of ventral surface, ×87; 27, lingula dorsal view, ×460; 28, base of cephalothoracic submedian seta, ×650. FIGS. 29, 30.—*C. diaphanum:* 29, outline, dorsal surface on right, ventral surface on left, ×87; 30, cephalic submedian seta, ×650. (Drawings by Mrs. Sara Hoke DeBord.)




FIGS. 16–30.—(See opposite page for explanation.)

Elizabeth G. Britton, February 18–March 4, 1907, U.S.N.H.; *C. northropiae* Britton, near Lisbon Creek, Mangrove Cay, Andros Island, Small and Carter, January 16–19, 1910, N.Y.B.G.

**Crenidorsum ornatum,** n. sp.

Figs. 10, 11

Differing from *C. tuberculatum* as follows: Marginal teeth more strongly tapered, apices narrower, about twice as long as wide, approximately 15 in 100$\mu$. Three or 4 scallops in a transverse row on cephalic segment, 30–34 in whole row, most scallops about one-half as long as height of ridge above them; outer side of ridge densely sclerotized but tending to be broken up, by less sclerotized indentations or lines running down ridges, into somewhat rectangular plates with a plate over each scallop; plates gradually increasing in size from ends of row to center, each one with longitudinal rows of heavily sclerotized, minute, stout spines; no membranous line at top of ridge but a furrow mesad of it on abdomen. Each median tubercle composed of 4–13 small tubercles each with numerous minute, stout spines. Submedian depressions and intersegmental sutures conspicuous, dotted and bordered with minute irregular areas and minute spines; mesometathoracic suture also with 2–6 pairs of longitudinal, sclerotized bars near median line; abdominal sutures extending to furrows mesad of ridges, ends of sutures 4–6 reflexed. Caudal setae 20–28$\mu$ long. Three pairs of outer subdorsal minute setae on cephalic segment. Outer disk pores approximately six times the width of a marginal tooth from submarginal teeth, about one-tenth as numerous as teeth; usually none between these and those distad of scallops, and no central subdorsal ones on cephalic segment; mesad of scallops, 1–4 (usually 2) subdorsal pairs of pores on abdominal segment 3, 1 or 2 (usually 2) on segment 4, and 1 or 2 (usually 1) on each of segments 5 and 6; submedian pair usually present on segment 6 (present in each available female, absent in only male available). Outer edge of rim usually moderately defined around anterior end of orifice. Caudal ridges and furrow rather well defined, extending nearly to submarginal teeth.

*Type.*—U.S.N.M. 56969. Parish of St. Thomas, Jamaica, from *Coccoloba.*

Described from six specimens from *Coccoloba longifolia* Fisch., from Jamaica: Parish of St. Thomas, N. L. Britton, September 15–19, 1908 (holotype), N.Y.B.G.; Holly Mount, Mount Diablo, W. R. Maxon, May 25–27, 1904, U.S.N.H.; Grier Field, near Moneague, Parish of St. Ann, N. L. Britton, April 3, 1908, N.Y.B.G.; Leicesterfield, Upper Clarendon, Wm. Harris, February 28, 1910, U.S.N.H.

**Crenidorsum leve,** n. sp.

Figs. 14, 15

Waxy secretion not observed. Differing from *C. tuberculatum* as follows: Body not narrowed on thorax. Derm colorless, membranous. Marginal teeth slightly wider than long, their sides moderately converging, their apices moderately curved; approximately 16 in 100$\mu$. Submarginal teeth apparently absent. Ridges from margin extending through outer subdorsum, central and inner subdorsum lightly sculptured. Scallops small, some poorly defined, contiguous or not, a sclerotized furrow as long as 4–6 scallops on cephalic segment, rows terminating on abdominal segment 4, sometimes only a furrow at posterior end, 40–55 scallops defined in each row; rows curved outward on meso- and metathorax; ridge over and mesad of scallops low, rounded, a shallow furrow mesad of it. Median tubercles absent. Cephalothoracic and eighth abdominal setae tapered from base, each about 6$\mu$ long; metathoracic pair at least their length from transverse molting suture; caudal setae approximately twice as far from vasiform orifice as from body margin. Subdorsal minute setae barely distinguishable, in outer subdorsum, 3 pairs on cephalic segment. Inner subdorsal minute setal bases absent. Inner margin of disk pores circular, they and porettes very minute; outer row of pores about seven times the width of a tooth from, and about one-tenth as numerous as, teeth; pores distad of scallops about one-fifth as numerous as scallops; nearly as many pores between these rows and on cephalic segment as in them; only 1 pair of inner subdorsal pores on prothorax and 2 inner subdorsal pairs (0 just laterocaudad of orifice) on eighth abdominal segment. No transverse sculpturing along median molting suture; intersegmental sutures extending at least to inner subdorsum. Vasiform orifice semioval, broad at posterior end, 44–56$\mu$ long and wide, more than twice its length from body margin; inner edge of its rim weakly defined around

anterior end of orifice, a very short lip between it and margin of orifice. Operculum weakly or not sculptured, slightly narrower than orifice at posterior end, not quite filling orifice. Ventral surface without a submarginal furrow.

*Type.*—U.S.N.M. 56970. Seven miles west of Ponce, Puerto Rico, from *Coccoloba*.

Described from five specimens as follows: *Coccoloba krugii* Lind., Little St. James Island, St. Thomas, Virgin Islands, Britton and Rose, February 27, 1913, N.Y.B.G.; *C. obtusifolia* Jacq., Puerto Rico, 7 miles west of Ponce, A. A. Heller, November 26, 1902 (including holotype), A.A., and between Guayanilla and Tallaboa, J. A. Shafer, March 13, 1913, U.S.N.H.

**Crenidorsum differens**, n. sp.

Figs. 16–18

Differing from *C. leve* as follows: Posterior part of body narrower and less broadly curved than anterior end. Marginal teeth twice as wide as long, merely shallow crenulations, approximately 13 in 100$\mu$. Ridges from margin ending in outer subdorsum. Scallops not actually defined but the outer side of a well-defined ridge, extending from cephalothoracic suture to fifth abdominal segment, sclerotized and tending to be divided into units suggesting scallops; no furrow mesad of ridge. A low median tubercle on each of abdominal segments 2–5. Each cephalothoracic submedian seta about 125, and each eighth abdominal and caudal seta about 100$\mu$ long, situated on tubercles; metathoracic pair the width of its tubercle from transverse molting suture. A low rachis extending from first abdominal suture to vasiform orifice. Vasiform orifice nearly twice its length from body margin. Caudal furrow and ridges unusually well-defined, reaching well toward margin.

*Type.*—U.S.N.M. 56971. Near Cudjoe Head, Montserrat, from *Coccoloba*.

Described from 45 specimens from *Coccoloba grandifolia* Jacq., from the Leeward Islands; near Cudjoe Head, Montserrat, J. A. Shafer, February 8, 1907 (including holotype), and Deshaies, Guadeloupe, H. Stehlé?, July 14, 1937, U.S.N.H.

**Crenidorsum marginale**, n. sp.

Figs. 19–21

Differing from *C. leve* as follows: Marginal teeth merely broad, short crenulations, about 18 in 100$\mu$. Subdorsal scallops and ridges absent, replaced by a lightly sclerotized, narrow furrow; portion of furrow on cephalic segment weak and continued from rest of furrow which terminates on abdominal segment 4 or 5. Submedian mesothoracic setae absent; caudal setae about half as far apart as eighth abdominal ones. Meso- and metathorax each with 2 inner subdorsal pairs of disk pores; first abdominal segment with 1 pair of submedian disk pores; eighth abdominal segment apparently with 3 pairs of pores (1 usually laterocaudad of orifice), anterior pair on this segment laterad or cephalolaterad of eighth abdominal setae. Transverse molting suture terminating at inner subdorsal furrows. Vasiform orifice 36–42$\mu$ long and wide, inner edge of its rim well defined around anterior end, a well-defined lip between it and margin of orifice. Operculum broad at posterior end, nearly truncate.

*Type.*—U.S.N.M. 56972. Barahona, Dominican Republic, from *Coccoloba*.

Described from three specimens from *Coccoloba pubescens* L., near Barahona, Dominican Republic, E. L. Ekman, September 11, 1926, U.S.N.H.

**Crenidorsum magnisetae**, n. sp.

Figs. 22, 23

Differing from *C. tuberculatum* as follows: Columns of white, flocculent, waxy material, supported on cephalothoracic and eighth abdominal setae, rising from dorsum, their ends curved outward and downward, covering and extending beyond the body.

Marginal teeth as wide as long. Three or four scallops on cephalic segment, a total of 26–36 in each row, terminating on abdominal segment 5; the majority one-half of the width to the width of a scallop apart, not quite so long as height of ridge over them; ridge low, broad, rounded, outer side not more heavily sclerotized than subdorsum, no membranous line at its top, a furrow mesad of it. Median tubercles absent. Each cephalothoracic and eighth abdominal seta approximately 60$\mu$ long, and 14–20$\mu$ in diameter at base, elongate conical, covered with minute spine-shaped designs in a netlike arrangement, set in thin collarlike bases; the eighth abdominal ones much nearer to posterior suture than to vasiform orifice and the area around their bases somewhat swollen; caudal setae as far apart as outermost point of

bases of eighth abdominal ones, usually located distad of caudal ridges. Three pairs of outer subdorsal minute setae on cephalic segment. One pair of inner subdorsal minute setal bases on prothorax. Mesad of scallops, 2 submedian disk pores at base of each cephalothoracic seta, no submedian pair on prothorax, anterior pair of posterior segment at bases of eighth abdominal setae. Intersegmental sutures reaching to furrows mesad of scallops; abdominal segment 7 practically as long as segment 6. Vasiform orifice broadly elliptical, slightly longer than wide, scarcely more than its length from body margin, about one and one-half times its length from posterior suture, unusually high; a narrow lip at anterior end, a shallow invagination between rim of orifice and lip. Caudal ridges rather well-defined opposite and just laterocaudad of orifice.

On ventral surface a few minute spines along tracheal tract from anterior edge of inner end of thoracic tracheal folds to anterior abdominal spiracles, mesad of each leg, and around adhesive sacs.

*Type.*—U.S.N.M. 56973. Grande Cayemite, Haiti, from *Coccoloba.*

Described from 16 specimens from *Coccoloba* spp. as follows: *C. diversifolia* Jacq., Grande Cayemite, Haiti, W. J. Eyerdam, August 1927 (including holotype), U.S.N.H., and below Hardware Gap, vicinity of Newcastle, Jamaica, Britton and Hollick, March 1, 1908, N.Y.B.G.; *C. retusa* Grieseb., Port Margot, Massif du Nord, Haiti, E. L. Ekman, December 11, 1924, U.S.N.H.; *C. revoluta* Leonard, vicinity of St. Michel de l'Atalaye, Department du Nord, Haiti, E. C. Leonard, November 20, 1925, U.S.N.H.

**Crenidorsum debordae,** n. sp.

Figs. 24, 25

Differing from *C. magnisetae* as follows: Caudal setae considerably farther apart than outermost point of bases of eighth abdominal setae. Usually 2 pairs of inner subdorsal minute setal bases on prothorax. Scallops about half as long as height of ridge over them; a well-defined furrow mesad of ridge. Inner edge of rim of orifice merging with margin at anterior angles of orifice, lip absent, a rather deep invagination in center of anterior margin of orifice. Ventrally, minute spines numerous, in a band well removed from margin, starting near median line on cephalic segment, passing outside legs, greatly widened posterior to legs and terminating a little anterior to ventral abdominal setae; also present mesad of legs, but few or none around adhesive sacs. Several ridges, divided into irregularly shaped areas, between minute spines and submarginal furrow, in center of cephalic segment and on abdominal segments 2–4.

*Type.*—U.S.N.M. 56974. Petite Gonave Island, Haiti, from *Coccoloba.*

Described from 12 specimens from *Coccoloba rotundifolia* Meissn., Haiti, Petite Gonave Island, E. C. Leonard, July 9 and 10, 1920 (including holotype), west of Cabaret, January 12, and vicinity of Bassin Bleu, April 17, 1929, E. C. and G. M. Leonard, U.S.N.H.

**Crenidorsum stigmaphylli,** n. sp.

Figs. 26–28

Differing from *C. magnisetae* as follows: Marginal teeth as wide as, or slightly wider than long, their sides nearly parallel and their apices broad, approximately 8 in 100$\mu$. No scallops on cephalic segment but a short sclerotized furrow suggestive of them; 20–26 scallops defined in each row, about half as long as height of ridge over them; a deep furrow mesad of ridge. A tongue-shaped projection extending inward from collar around base of each submedian cephalothoracic seta; caudal setae located rather near ends of posterior suture, slightly farther apart than outermost point of bases of eighth abdominal setae. Two pairs of inner subdorsal minute setal bases on prothorax and 1 usually present on abdominal segment 6. Inner edge of orifice rim merging with margin at anterior angles of orifice, lip absent, a deep, broad invagination in anterior margin of orifice. Caudal ridges opposite orifice. On ventral surface a band of ridges extending inward from submarginal furrow, majority of ridges divided into irregularly shaped areas (more distinct in mature than in recently emerged pupae), absent from tracheal folds and area adjacent to abdominal tracheal fold. Minute spines in a band reaching from ridges to submedian area, present across tracheal folds; also present around mouthparts, adhesive sacs, and legs.

*Type.*—U.S.N.M. 56975. Ponce, Puerto Rico, from *Stigmaphyllon.*

Described from numerous unmounted specimens and 28 mounted ones from *Stigmaphyllon;*

*S. sagraeanum* A. Juss. (determined by C. V. Morton, U. S. National Herbarium), Hanabanilla Falls, near Cumanayagua, Santa Clara, Cuba, H. G. Myers, April 7, 1925; *Stigmaphyllon* sp., Ponce, Puerto Rico, Martorell and Wolcott, May 20, 1937 (including holotype).

**Crenidorsum diaphanum,** n. sp.

Figs. 29, 30

Waxy secretion not observed. Differing from *C. magnisetae* as follows: Derm membranous, colorless. Marginal teeth slightly wider than long, their sides moderately converging, approximately 15 in 100$\mu$. Submarginal teeth very faint, in basal part of marginal teeth. Rows of scallops terminating on sixth abdominal segment, 36 or 37 (observed) in each row. Submedian meso- and metathoracic setae absent; cephalic and eighth abdominal ones 30–40$\mu$ long, and 6–8$\mu$ in diameter at base; eighth abdominal ones located about twice as far from vasiform orifice as from posterior suture, area around their bases not swollen; caudal setae located just before bases of marginal teeth, as far apart as innermost point of bases of eighth abdominal ones. Disk pores outside scallops about one-third as numerous as scallops; submedian disk pores absent from thorax. Vasiform orifice approximately its length from posterior suture and about one and one-half times its length from body margin; a faint indication of an invagination between rim and lip at anterior end of orifice. Ventrally no submarginal furrow; ridges extending inward from margin except in and on each side of tracheal folds, majority of them divided into irregularly shaped areas; a band of minute spines mesad of ridges, extending to submedian area on abdomen, none or few mesad of legs and around adhesive sacs; very minute spine-shaped markings in median area of abdomen.

*Type.*—U.S.N.M. 56976. West of Cabaret, Haiti, from *Coccoloba.*

Described from three specimens from *Coccoloba rotundifolia* Meissn., west of Cabaret, Haiti, E. C. and G. M. Leonard, January 12, 1929, U.S.N.H.

## ZOOLOGY.—Malacobdella minuta, *a new commensal nemertean.*[1] WESLEY R. COE. Osborn Zoological Laboratory, Yale University, and Scripps Institution of Oceanography, University of California. (Communicated by WALDO L. SCHMITT.)

The new species of nemertean described herein is of interest because it presents several morphological deviations from the three previously described representatives of the order Bdellonemertea. This order contains but a single genus, *Malacobdella*, the species of which are highly specialized for a commensal life within the mantle or pulmonary cavities of various mollusks. One of these species, *Malacobdella grossa* (O. F. Müller), which is specifically identical with *M. mercenaria* and *M. obesa* Verrill, is widely distributed in pelecypods on the coasts of Europe and on both the Atlantic and Pacific coasts of North America. Another species (*M. japonica* Takakura) has been reported only from the coasts of Japan. The third species was found in the pulmonary cavity of a fresh-water snail in Chile.

[1] Received September 1, 1944. Contributions from the Scripps Institution of Oceanography, New Series No. 243.

### DESCRIPTION

**Malacobdella minuta,** n. sp., is a dwarf form, with a combination of characteristics by which it is easily distinguished from *M. grossa*, also found on the coast of California, as well as from *M. japonica*. It differs particularly from *M. grossa* in its small size when mature, in having few and relatively large gonads, arranged in a single irregular row, in having dorsolateral nephridiopores, and in the short proboscis chamber. The chief distinctions from *M. japonica* are size, arrangement and number of gonads, length of proboscis sheath, and position of posterior nerve commissure. Minor differences from each of these species are indicated in the following paragraphs:

Length of sexually mature type specimen only 5 to 8 mm, according to state of contrac-

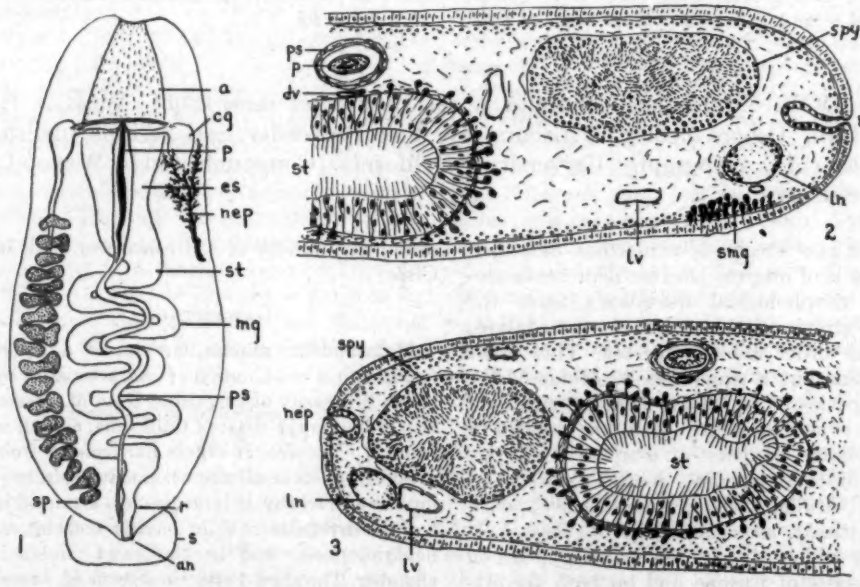
tion, as compared with 20 to 50 mm in the other two marine species. Width 2 mm.

Color whitish and translucent; intestine pale yellow; spermaries opaque white.

*Proboscis.*—The proboscis sheath extends nearly the entire length of the body, as in *M. grossa*, while this organ is only two-thirds as long as the body in *M. japonica* (Takakura, 1897; Yamaoka, 1940). The proboscis fills most of the cavity of the rhynchocoel and is therefore coiled only as much as the sheath. It has only a single chamber and this extends posteriorly somewhat less than half the length of the body (Fig. 1). After eversion it is withdrawn by a long retractor muscle which extends the entire length of the sheath. Near the base of the sucker this long, slender muscle passes through the end of the sheath and some of its fibers become interlaced with fibers from the dorsal body wall, as Riepen (1933) and others have described for *M. grossa*. The proboscis chamber is relatively much shorter and the retractor muscle correspondingly longer than in *M. grossa*.

*Vascular system.*—The two lateral blood vessels are much branched, as in other species of the genus, and have the usual dorsal cephalic anastomosis. In the brain region there is a second anastomosis on the dorsal side of the esophagus. From this anastomosis the dorsal vessel originates and the three longitudinal vessels are united posteriorly on the dorsal side of the rectum.

*Excretory system.*—The single pair of nephridia extend from near the brain through most of the anterior half of the body (Fig. 1). The profusely branching tubules lie in the parenchyma dorsal to the lateral nerves and adjacent to the main lateral blood vessels. They unite posteriorly to form a pair of large efferent ducts which lead to the exterior on the dorsolateral surfaces of the body (Figs. 2, 3). In this respect the species resembles *M. japonica* and differs from *M. grossa*. In the latter the nephridiopores are ventrolateral.




*Malacobdella minuta*, n. sp.: FIG. 1.—Diagram of organ systems from dorsal surface, showing atrium (*a*), anus (*an*), cerebral ganglia (*cg*), esophagus (*es*), midgut (*mg*), one of the nephridia (*nep*), proboscis (*p*), proboscis sheath (*ps*), rectum (*r*), sucker (*s*), spermaries (*sp*) and stomach (*st*). FIG. 2.—Portion of transverse section through posterior portion of anterior half of body, showing right efferent nephridial duct (*nep*) opening on dorsolateral surface. Other letters indicate: *dv*, dorsal blood vessel; *ln*, lateral nerve cord; *lv*, lateral vessel; *p*, proboscis; *ps*, proboscis sheath; *smg*, submuscular glands; *spy*, spermary; *st*, stomach with columnar ciliated epithelium surrounded by gland cells. FIG. 3.—Portion of transverse section of body, showing left efferent nephridial duct (*nep*) on dorsolateral surface. Other letters as in Fig. 2.

The efferent ducts lie at the posterior end of the nephridial system and in the region where the stomach enters the midgut. This is also the region where the lateral blood vessels move from the dorsolateral to the ventrolateral portion of the parenchyma and a short distance behind the most anterior gonads (Fig. 1).

*Digestive system.*—The broad atrium extends from near the tip of the head to the brain commissures where the proboscis opens through its dorsal wall. Posterior to the proboscis opening the digestive canal continues as the esophagus without change in the size of the lumen or in the character of the lining epithelium of short ciliated cells. In the region of the nephridiopores and the most anterior gonads the lumen becomes narrower, the ciliated epithelium more highly columnar and the large, subepithelial gland cells in the parenchyma on the external border of the epithelium become more numerous. This part of the gut is correctly designated as the stomach (Figs. 1, 2, 3). This specimen shows no indication of the caecum which Riepen (1933) describes as occurring between foregut and midgut in *M. grossa*. There is no abrupt change but only a gradual transition in the lumen as well as in the epithelium between esophagus and stomach and between stomach and midgut.

Posterior to the stomach the slender midgut bends alternately to left and right, forming three loops or convolutions on the right side of the body and four on the left. The midgut terminates in the median rectum which opens on the dorsal side of the sucker (Fig. 1).

*Nervous system.*—The two cerebral ganglia are widely separated by the broad atrium (Fig. 1) and are connected by the usual small dorsal and large ventral commissures. Each ganglion has but a single fibrous core and is without division into dorsal and ventral lobes. At the posterior end of the body the lateral nerve cords are united by a slender commissure situated on the dorsal side of the rectum and in close connection with the anastomosis of the three longitudinal blood vessels. In this respect the species resembles *M. grossa* and differs from *M. japonica*. In the latter the commissure is stated to lie in the sucker and posterior to the anus (Takakura, 1897; Yamaoka, 1940).

*Reproductive system.*—In the single male available for study the gonads are situated in a single irregular row on each side of the body. In this specimen, which was sexually mature, there are 18 pairs of large spermaries filled with apparently mature spermatozoa (Fig. 1). In this respect *M. minuta* differs from either of the two other marine species, in which the gonads are relatively small and very numerous. In this new species they are arranged much as in typical hoplonemerteans. Female at present unknown.

*Habitat.*—Commensal in the mantle cavity of *Yoldia cooperi* Gabb. Collected by Dr. Martin Johnson off Point Loma, southern California, at a depth of 40 meters.

Type in Peabody Museum, Yale University.

The four species of *Malacobdella* at present known may be distinguished by the following key:

1. Commensal in marine pelecypods.....2
   Commensal in fresh-water gastropod.....*auriculae*
2. Proboscis sheath nearly as long as body; posterior commissure of nerve cords on dorsal side of rectum.....3
   Proboscis sheath only two-thirds as long as body; posterior commissure of nerve cords in sucker.....*japonica*
3. Nephridiopores on dorsolateral surfaces; gonads large, situated in a single irregular row on each side of body.....*minuta*
   Nephridiopores on ventrolateral surfaces; gonads relatively small and very numerous, irregularly scattered.....*grossa*

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LINGUISTICS.—*Origin of the word "maize."*[1] JOHN P. HARRINGTON, Bureau of American Ethnology.

"Corn" is the same word as "grain." Corn comes from the Anglo-Saxon, grain from the Latin, the two forms being different pronunciations of the same word, which originally referred to any kind of grain. As late as in the time of Queen Elizabeth in England "corn laws" were enacted. Needless to say, they did not refer to Indian corn but to any kind of grain.

When America was discovered, a new kind of seed grass was seen for the first time, the kernels of which were so large and delicious that there was nothing like them in Europe. The Spanish discoverers did not know what to call this plant, which is now known in English as Indian corn, or simply as corn. One of the early Spanish writers termed it bledo de las Indias, wheat of the Indies.

Oviedo was a Spanish writer and student who made his home at Puerto Plata (Silver Harbor) on the island of Santo Domingo for 20 years or more, perhaps from 1520 to 1540. During this period he was writing his *General and tribal history of the Indies*. The native Indian languages of the West Indies were still spoken at this early time, which was only a few years after the discovery of the islands by Columbus. Oviedo, whose full name was Gonzalo Fernández de Oviedo y Valdés, is the only writer who shows how the Indians were abused and makes it apparent how they later became extinct through the introduction of colored slaves. His book remained in manuscript form 311 years, until it was printed in Madrid, Spain, in 1851 and was thus made available to historians of the modern world. By the time this history was published the Indian language had long since given way to Spanish in the islands. Any Indian words that Oviedo writes about are therefore important, for what he says constitutes perhaps our only source of definite information.

The word "maize" is first recorded by Oviedo as the word for corn in the Cuban dialect of Arawak, and he gives the native original form in two spellings: "maisi" and "majisi." What is the phonetic interpretation of these spellings? It is that the word starts off with mah-, which is followed by -hi- (this syllable in colloquial Spanish reduced to the second member of a diphthong), and the word is then closed by a third and final syllable -si. By giving two spellings Oviedo makes it possible to know exactly what the pronunciation was. Though the Arawak language has for centuries been dead in the islands, there are Indians on the mainland of South America, for instance, in Guiana, who still speak a different dialect of it, and in their dialect, if we look for the word for corn, we find "marise." Why should -r- take the place of Oviedo's -j-? No one knows.

This old native Cuban word for corn was taken into Spanish as maíz—with an accent written on the i to show it is a separate syllable. In Spanish dialects the word is often pronounced the same as English mice (plural of mouse), but in more "highbrow" Spanish it should be ma-ís, with the accent on the second syllable. It will be seen that only the -j- and final -i of Oviedo's word are missing. This Spanish word is the name for corn in practically all the languages of Europe and Asia except English, in which the old inherited word corn, taking on a new restricted meaning, has knocked it out. The Carib Indian work for corn is similar to and cognate with the Arawak Indian word for corn.

The botanical name of the plant, *Zea mays*, was given by none other than the great Linnaeus, father of modern botanical nomenclature. But Linnaeus spelled the word "mays" wrongly. Spanish z is pronounced in the New World as s, but the writing of y instead of i is far from the spelling given by Oviedo.

What is the etymology of this old Arawak word for corn, which has come to be on the tongue of German, Russian, French, Italian, and Hungarian? To what verb is it perhaps related? This again no one knows.

[1] Received August 21, 1944.